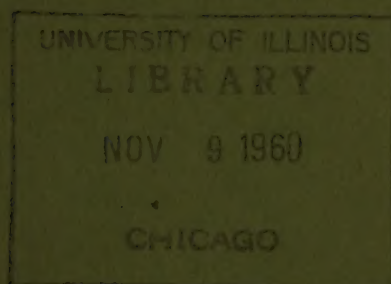


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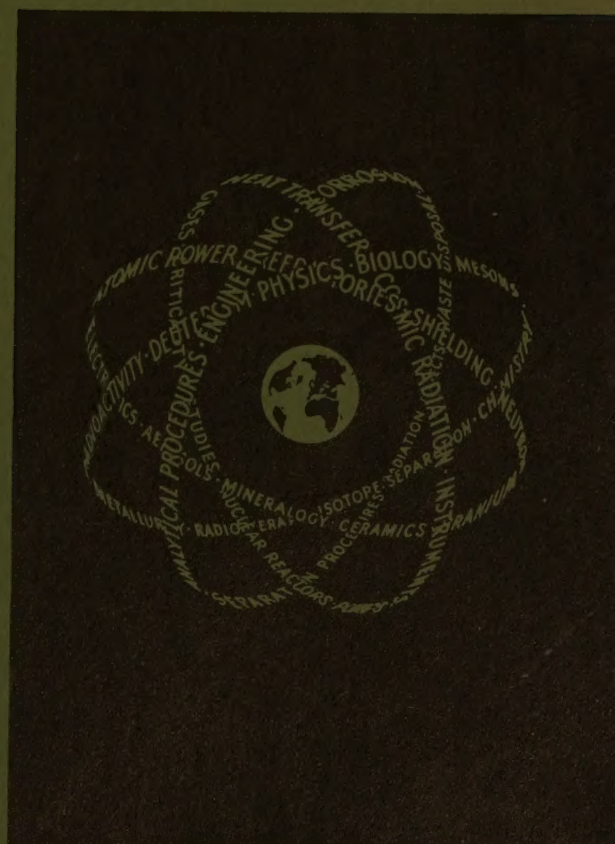
NUCLEAR SCIENCE ABSTRACTS



October 15, 1960

Volume 14 Number 19

Abstracts 18708-20043



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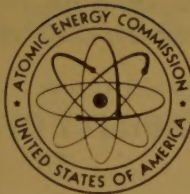
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A Semimonthly Publication of the United States Atomic Energy Commission Office of Technical Information

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NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 19

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GENERAL AND MISCELLANEOUS

18708 ANL-5000

Argonne National Lab., Ill.

CHEMISTRY DIVISION, SECTION C-II SUMMARY REPORT FOR JULY, AUGUST, AND SEPTEMBER 1952. J. R. Gilbreath and O. C. Simpson, comps. Jan. 21, 1953. Decl. May 3, 1960. 76p. Contract W-31-109-eng-38. OTS.

The progress of the work is reported on the physical properties of graphite; effect of reactor radiation on the properties of graphite; effect of irradiation on ceramic materials; x-ray-induced luminescence of ice; investigation of color centers and other optical properties of single crystals; radiation chemistry of liquids; application of mass spectrometry to chemical problems; vapor pressure and heat of vaporization of U; nuclear properties of Zr^{93} and Nb^{93m} ; mass distribution in the spontaneous fission of Cm^{242} ; upper limit to lifetimes of first excited states of Th^{230} , U^{234} , and Pu^{238} ; spectrographic and chemical analysis; and design and performance of the 60-in. cyclotron. (For preceding period see ANL-4888.) (B.O.G.)

18709 HW-49008

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DISPERSION OF DISSOLVED MATERIAL IN THE COLUMBIA RIVER. J. F. Honstead. Mar. 12, 1957. 16p. Contract W-31-109-Eng-52. OTS.

The mixture of short-lived radioisotopes in the effluent from the Hanford reactors was used as a tracer of the dispersion pattern in the Columbia River. The traverses sampled were selected to be as nearly normal to the direction of flow of the main current of the river as could be judged visually. The cross-sectional shape and measured velocity pattern of each traverse are plotted. Factors which limited the precision of the data are discussed. (C.H.)

18710 HW-65078

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

UNCLASSIFIED RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT AND THE DIVISION OF RESEARCH [FOR] APRIL 1960. L. H. McEwen, comp. May 10, 1960. 60p. Contract AT(45-1)-1350. OTS.

A 19-rod Zircaloy-clad half-length PRTR spike element successfully irradiated to high plutonium burnout at full power in the ETR showed partial bonding of the core and cladding. Fuel rods, composed of various UO_2 powders contained in various cladding materials, were successfully swaged at cladding temperatures up to 1000°C. Prototypi-

cal PRTR tubular UO_2 fuel elements were fabricated by vibrational compaction. The over-all PRTR project is reported to be approximately 86% complete. The bottom PRTR shield was installed and filled with shot. Lowering the molten salt temperature from 750 to 700°C during electrodeposition of UO_2 appeared to improve the oxygen-to-uranium ratio. The initial batch produced at 700°C exhibited a ratio of 2.01. X-ray-diffraction studies were completed on ZrO_2 - PuO_2 mixtures sintered at 1500°C for eight hours. The compound $PuAlO_3$ was produced from stoichiometric mixtures of Al_2O_3 and PuO_2 in eight hours at 1500°C in hydrogen. Measurement of k_{∞} and f for the EGCR lattice with 2.6 wt.% enriched fuel was completed. Reactivity effects of substituting graphite spiders and end caps for stainless steel components in the EGCR were determined. Experiments to date reveal that reaction rates of CO_2 and graphite are independent of geometry. Calculations were made of transient loop temperatures following loss of helium shroud coolant. Purex waste was neutralized with calcium hydroxide rather than caustic prior to calcination. The slurry was calcined, producing a powder of density 0.7 g/cc. Weight loss on heating was substantially less than previously observed. (For preceding period see HW-64865.) (C.J.G.)

18711 IDO-16620

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT [FOR] OCTOBER 1-DECEMBER 31, 1959. May 20, 1960. 75p. Contract AT(10-1)-205. OTS.

As steps toward the eventual full experiment loading of the ETR, two loading arrangements of fuel elements containing 320 and 400 g U^{235} were investigated in the ETRC. An improved coolant flow alarm-scrum system for ETR using a band pass amplifier and differential pressure transducers has demonstrated its ability to maintain protection of the reactor, yet avoid nuisance scrams. Response of the RMF's servo-ionization chamber to gamma rays from a 400-curie in source in the experiment position was found to be less than 0.1% of the response to neutron flux at power. A comparison of burnup estimates in sample fuel plates based on RMF measurements to those based on destructive isotopic distribution analyses show very good agreement. The self-shielding factor for 40 mil Co wire for three MTR facilities was found to be 1.18 while resonance neutron self-shielding factor was found to be 2.20. The Cd ratio (fission) for U^{235} was found to be 10.5 for 10 mil U-Al, based on measurements in four ETRC fuel positions. In the cross section measurement program, simultaneous total and fission cross section measurements

on U^{233} with the fast chopper were completed for the 16 m flight path, and the resonance parameters obtained from a multilevel analysis are presented. A value of 211 ± 5 barns was obtained for the 2200 m/sec cross section of Pu^{231} . Preliminary results were obtained in the determination of alpha for U^{235} in a well thermalized spectrum. The isomer yield ratios for epi-Cd and thermal neutron capture in In^{115} , Cs^{133} , Ta^{181} , and Eu^{151} were measured. Additional measurements were made of the decay of 15 day Eu^{156} and the decay scheme was revised accordingly. Further measurements on radiations following decay of Sm^{155} have resulted in a revision of previous assignments of nuclear spins for the levels in Eu^{155} . (For preceding period see IDO-16580.) (W.L.H.)

18712 LA-2331UNM
New Mexico. Univ., Albuquerque.

BEHAVIOR OF CARRIER-FREE TRACERS. (A Bibliography of Unclassified References). Milton Kahn, Kent H. Jones, and Kathryn Lawson. July 1959. 127p. For Los Alamos Scientific Lab. OTS.

A bibliography containing 1216 references to unclassified work on the behavior of carrier-free tracers is presented. Information is included on the preparation, coprecipitation, adsorption, emanation, diffusion, solvent extraction, volatilization, oxidation-reduction, and electrolysis of carrier-free tracers. The references were obtained from Chemical Abstracts and Nuclear Science Abstracts, 1950-1957, inclusive. (auth)

18713 NP-8581
Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.

THE ITALIAN NUCLEAR PROGRAM IN THE FRAMEWORK OF U.S.-EURATOM CO-OPERATION. F. Ippolito. 1959. 7p.

Speech at Meeting of American Nuclear Society (Washington Section) on September 16, 1959.

18714 UCRL-6008
California. Univ., Livermore. Lawrence Radiation Lab. SOME POTENTIAL USES OF NUCLEAR EXPLOSIVES IN THE CONSERVATION AND DEVELOPMENT OF WATER RESOURCES. May 24, 1960. 26p. Contract W-7405-eng-48. OTS.

In nuclear explosives man has at his disposal and service a powerful source of energy that can be utilized safely to excavate channels and lake basins, to create conduits of broken permeable material, and to form underground reservoirs. Possible applications of nuclear explosives include the economic movement of large volumes of earth in the construction of earthfill dams, diversion of a stream from a river system whose flow is largely lost to the sea into another stream channel leading to an arid section or a closed basin, the creation of a recharge basin or a conduit to a subsurface aquifer for fresh water recharge, and the creation of off-channel reservoirs for the elimination of saline waters through recharge to a mineralized aquifer and by evaporation. Fields which need to be explored include engineering, geology, and geohydrology. The future exploration and development of peaceful uses of nuclear explosives in the field of water resources will require an inter-disciplinary effort. (auth)

18715 WAPD-BT-18
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY. Apr. 1960. 137p. Contract AT-11-1-GEN-14 and appropriate NObs-Contracts. OTS.

Ten papers are presented. Separate abstracts have been prepared for each paper. (W.L.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

18716 A/AC.82/G/L.334
Institut Pasteur. Institut National D'Hygiene, Paris and France. Service Central de Protection Contre les Rayonnements Ionisants, Paris.
ETUDE AUTORADIOGRAPHIQUE DU METABOLISME DU 131 IODE CHEZ LE RAT. (Autoradiographic Study of Iodine 131 Metabolism in Rats). Pierre Pellerin and Marie-Renee Siroux. Jan. 18, 1960. 7p.

The tissue distribution of injected I^{131} in rats was followed at times varying from 30 sec to 14 hr after injection. The animals were sacrificed and autoradiograms prepared from quick-frozen tissues. Systematic examinations were also made on I^{131} levels in saliva at various times after administration. Results are described, and photographs of autoradiograms are included. (C.H.)

18717 ACRH-13
Argonne Cancer Research Hospital, Chicago.
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Leon O. Jacobson, ed. Mar. 1960. 120p. Contract AT(11-1)-69. OTS.

Separate abstracts have been prepared on 10 papers covering research carried out or completed during the period. A list is included of staff publications. (For preceding period see ACRH-12.) (C.H.)

18718 ACRH-13(p.1-8)
Argonne Cancer Research Hospital, Chicago.
STUDIES ON ERYTHROPOIESIS. XVI. THE RESPONSE TO A SINGLE DOSE OF ERYTHROPOIETIN IN THE POLYCYTHEMIC MOUSE. B. S. Filmanowicz and C. W. Gurney. p.1-8 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

The response to a purified preparation of erythropoietin as measured by counts of erythrocyte cells in the spleen, and of peripheral reticulocytes, was studied in the polycythemic mouse. Following a single injection of erythropoietin, an orderly wave of erythropoiesis was observed to sweep through the spleen. Graded responses were obtained for doses ranging between 0.75 and 6 units. Although the peak reticulocyte count persisted longer following large doses, no higher reticulocyte count was obtained in doses above 6 units. Implications of these observations are discussed. (auth)

18719 ACRH-13(p.9-22)
Argonne Cancer Research Hospital, Chicago.
TRANSFUSION-INDUCED POLYCYTHEMIA AS A MODEL FOR STUDYING FACTORS INFLUENCING ERYTHROPOIESIS. L. O. Jacobson, E. Goldwasser, and C. W. Gurney. p.9-22 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

In the polycythemic mouse, the entire blood-forming tissue remains apparently devoid of erythropoietic activity, or this function is dormant until exogenous erythropoietin is administered, or endogenous erythropoietin production is restored either by reducing the hematocrit to its normal range, or by the administration of a stimulus such as cobalt ion. The stimulus may act upon any one of a number of cells, including the dormant primitive erythroblasts, the red cell precursors, and the multipotential cells in the bone marrow. The bone marrow

of these polycythemic mice, which is apparently dormant or inactive insofar as erythropoiesis is concerned, retains the capacity to initiate erythropoiesis equally as effectively as normal marrow, when transplanted into isologous or homologous supralethally-irradiated mice. Heterologous (rat) marrow may be transplanted to the polycythemic supralethally-irradiated mouse and suppression of erythropoiesis maintained by postirradiation transfusion. Such suppression does not interfere with the growth of other transplanted cell types, and the mouse survives. On reduction of the hematocrit or red cell mass to, or below, the normal range, rat red cell precursors multiply and repopulate the mouse hematopoietic tissue. These studies suggest that the isologous, homologous or heterologous transplant contains dormant erythroblasts capable of being activated, or that erythropoiesis may arise under these circumstances from multipotential cells in the transplant. Using the polycythemic mouse as a subject, the site of action of erythropoietin has been explored and appears to involve principally those undifferentiated precursors which may be proerythroblasts or even still more primitive cells. (auth)

18720 ACRH-13(p.23-32)

Armour and Co. Research Div., Chicago.

PURIFICATION OF SHEEP ERYTHROPOIETIN. W. F. White and E. Goldwasser. p.23-32 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

Procedures are described for the preparation and purification of a concentrate erythropoietin preparation derived from anemic sheep plasma. (C.H.)

18721 ACRH-13(39-51)

Chicago. Univ.

THE RETICULOENDOTHELIAL SYSTEM IN ANTIBODY FORMATION. R. W. Wissler, F. W. Fitch, and M. F. LaVia. p.39-51 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

The evidence implicating several cell types in the antibody-forming mechanism was reviewed. Mesenchymal cell interrelationships have been outlined. An effort was made to indicate how the recorded observations of cellular progressions during primary and secondary immune reactions fit into this scheme of cell organization. In particular, the histological patterns observed in the rat spleen after a single particulate antigen injection were compared with those in the spleen and elsewhere after multiple antigenic stimuli. The relation of these observations to Burnet's clonal selection theory is emphasized. The cellular sequence of events is discussed in the light of the possible implications of the physical state of the antigen, the route of injection, the presence of reproducing antigens (bacterial and cellular) and the species studied. (auth)

18722 ACRH-13(p.52-4)

Chicago. Univ.

THE EFFECT OF L-TRIiodOTHYRONINE ON RADIATION SENSITIVITY. M. L. Griem and J. A. Stein. p.52-4 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

Triiodothyronine can be used both experimentally and clinically to produce a qualitative change in the radio-sensitivity of certain selected tissues. In the case of melanoma, the administration of L-triiodothyronine did not increase radiation sensitivity to a degree sufficient to control this tumor. The ease with which the metabolic state can be controlled and modified, both experimentally and clinically, by this drug makes it a useful tool. The fact that unirradiated lesions have a higher growth rate when a patient is in the hypermetabolic state makes the

selection of patients for this method of treatment a matter of great importance. It may also indicate one of the mechanisms of increased radiation sensitivity, since rapidly growing tissue is usually considered to be more radiosensitive. (auth)

18723 ACRH-13(p.55-61)

Argonne Cancer Research Hospital, Chicago.

THE REGULATION OF IRON ABSORPTION. I. A SEARCH FOR HUMORAL FACTORS. E. Beutler and E. Bittenwieser. p.55-61 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

No humoral stimulation or depression of iron absorption could be demonstrated following the injection of plasma from iron-deficient rats into normal mice and normal rats; the injection of plasma from normal rats into iron-deficient rats; or the injection of crude extracts of rat liver, spleen, kidney, and bone marrow into normal rats. (auth)

18724 ACRH-13(p.62-9)

Chicago. Univ.

STUDIES ON ANTIBODY PRODUCTION BY SPLEEN EXPLANTS MAINTAINED IN VITRO. M. F. La Via, S. A. Uriu, and L. A. Ferguson. p.62-9 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

A maintenance tissue culture system was designed for the study of the spleen of rats given one intravenous dose of a particulate antigen. Antigen was synthesized as evidenced by a rise in antibody content in the tissue culture medium and incorporation of a radioactive amino acid by material specifically bound to antigen. This synthesis was accompanied by cellular differentiation similar to that described *in vivo* during antibody synthesis but mitoses were not observed. (auth)

18725 ACRH-13(p.70-94)

Chicago. Univ.

THE METABOLISM OF PROGESTERONE AND ITS RELATED COMPOUNDS IN HUMAN PREGNANCY. M. E. Davis, E. J. Plotz, C. I. Lupu, and P. M. Ejarque. p.70-94 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

Results are presented from an investigation of the metabolic fate of tagged progesterone and 17(α)-hydroxyprogesterone caproate administered to pregnant women. (C.H.)

18726 ACRH-13(p.96-105)

Chicago. Univ. and Sloan-Kettering Inst. for Cancer Research, New York.

FEVER-PRODUCING STEROIDS OF ENDOGENOUS ORIGIN IN MAN. A. Kappas, W. Soybel, P. Glickman, and D. K. Fukushima. p.96-105 of SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

A number of endogenous steroids of the 5 β -H series (pregnane and etiocholane) was examined for pyrogenic action in man. Three α -hydroxyetiocholane-17-one; 3 α , 11 β -dihydroxyetiocholane-17-one; etiocholane-3,17-dione; 3 α -hydroxypregnane-20-one; pregnane-3,20-dione; 3 α -hydroxypregnane-11,20-dione; pregnane-3 α ,20 α -diol; and 21-hydroxypregnane-3,20-dione possessed varying degrees of such activity. Replacement of the C3-alcohol group of 3 α -hydroxyetiocholane-17-one and 3 α -hydroxypregnane-20-one with a ketone resulted in significant suppression of pyrogenic activity. Incorporation of an oxygen atom at C11 of the etiocholane or pregnane nucleus similarly modified pyrogenic activity of the parent steroid, but the effect was much less marked for the C21 compound than it was for the 17-ketosteroid. Acetylation of 3 α -hydroxyetiocholane-17-one and 3 α -hydroxypregnane-20-

one completely eliminated fever-provoking activity and a similar effect was noted following incorporation of an alcohol group at C17 of the pregnane compounds. These studies are of interest in the following respects because they establish the existence of a new form of biologic activity for a class of steroids generally considered physiologically inert; they suggest the possibility of other unrecognized types of biologic activity among the large number of hormonal transformation products in man; they define a new class of pyrogenic substances and represent the first demonstration of the consistent pyrogenic activity of pure compounds of known chemical structure and of endogenous origin in man; and they provide a useful experimental means for studies on the physiologic effects and mechanism of fever in man. (auth)

18727 ACRH-13(p.106-8)

Argonne Cancer Research Hospital, Chicago.

SPECIES SPECIFICITY OF STEROID-INDUCED FEVER. A. Kappas and B. Ratkovits. p.106-8 of SEMI-ANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

Previous studies from these laboratories have demonstrated that a number of steroid metabolites of the 5 β -H type (pregnane and etiocholan) derived from adrenocortical and gonadal hormones provoke fever when administered intramuscularly or intravenously to man. These pyrogenic hormonal transformation products include C19 and C21 steroids of both the 11-desoxy and 11-oxygenated series such as 3 α -hydroxyetiocholan-17-one; pregnane-3 α ,20 α -diol; 3 α -hydroxypregnan-20-one; 3 α ,11 β -dihydroxyetiocholan-17-one; and 3 α -hydroxypregnan-11,20-dione. These studies established the existence of a new form of biological activity for a class of compounds previously considered physiologically inert and defined a new category of potent fever-producing substances of endogenous origin in man. Further studies of the biological properties of these compounds have led to the demonstration of an apparent high degree of species specificity of steroid-induced fever. Three α -hydroxypregnan-11,20-dione, a metabolite of endogenous hormones is intensely pyrogenic when administered by intramuscular or intravenous injection to man in doses of approximately 0.2 to 1.0 mg/Kg body weight. This steroid, dissolved in small amounts of sesame oil-benzyl alcohol vehicle was given by intramuscular injection in doses of 1.0 and 5.0 mg/Kg to between 8 and 12 animals of each of the following species: rat, mouse, guinea pig, dog, cat, rabbit, and monkey (*M. Rhesus*). In addition, 2 animals of each of the 4 latter species were given intravenous injections of the steroid in doses of 1.0 mg/Kg. In order to demonstrate that the laboratory environment and conditions of mild physical restraint and animal handling used in these experiments did not inhibit fever production, these animals were later given intravenous injections of bacterial pyrogen (Piromen). Temperatures were measured rectally by means of indwelling thermistor probes and were recorded continuously during appropriate control periods and for 18 to 24 hours after injections. Data are summarized and results are discussed. (C.H.)

18728 ACRH-13(p.109-16)

Sloan-Kettering Inst. for Cancer Research, New York. STUDY OF THE GENETIC AND EXTRA-GENETIC DETERMINANTS OF α -KETOSTEROID PRODUCTION IN MAN. A. Kappas and T. F. Gallagher. p.109-16 of SEMI-ANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION.

The steroid patterns of normal, adult male, dichorionic

monozygotic triplets were examined in detail during control periods and during adrenocortical stimulation with ACTH. In two triplets these patterns were virtually identical, before, during, and after ACTH administration. In view of the highly individual nature of these patterns, this is impressive evidence of a genetic influence on steroid hormone production and metabolism in man. The third triplet, however, produced significantly smaller amounts of individual ketosteroids as compared with his brothers, during all periods. This finding is interpreted as evidence for the existence of an extragenetic influence by means of which steroid production or metabolism was modified. Related physiologic differences in monochorionic twins were attributed to demonstrated vascular asymmetry and unequal distribution of the mutual fetal circulation to one partner of the pair. The birth membranes of these triplets were dichorial in character and it is evidence that a fetal situation comparable to that seen in monochorionic twins existed for two of the brothers. It is presumed, therefore, that the triplet with divergent steroid patterns was the deprived member of this pair, and that his differences in production or metabolism of steroids represent a physiologic aftermath of a relatively deficient fetal circulation. (auth)

18729 AD-234943

General Electric Co. Flight Propulsion Lab., Dept., Evendale, Ohio.

PROTECTIVE COATINGS FOR MOLYBDENUM ALLOYS. Interim Report No. 2 Covering Period July 1, 1959–September 30, 1959. W. B. Hall. Oct. 15, 1959. 19p. Contract NOas 59-6026-C.

Tests of glass-impregnated flame-sprayed alumina for molybdenum oxidation protection are reported. Maximum life of the coating was 100 hours under static oxidation conditions at 2300°F. Results and pictures of commercial coating evaluation are included. (J.R.D.)

18730 AERE-MED/R-2317

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

NEUTRON ACTIVATION ANALYSIS OF BLOOD. W. P. Hutchinson. Apr. 1960. 8p. BIS.

A neutron activation determination of the sodium content in the blood of 24 persons revealed amounts of 1.6 to 2.0 mg/ml. The amount of Na²⁴ produced was determined from the Na²³(n, γ)Na²⁴ reaction. (C.J.G.)

18731 CNI-31

Italy. Comitato Nazionale per le Ricerche Nucleari.

Centro Nazionale per le Ricerche Nucleari, Ispra. ON A METHOD OF PREPARATION OF COLLOIDAL RADIO-GOLD (Au¹⁹⁸). A. M. Del Turco and R. Pietra. May 1960. 17p.

Studies are reported on a method of preparation of colloidal radio-gold (Au¹⁹⁸) for medical use. The colloid obtained presents great stability and uniformity with average size of particles of 250 \pm 50 Å. (auth)

18732 CNI-32

Italy. Comitato Nazionale per le Ricerche Nucleari.

Centro Nazionale per le Ricerche Nucleari, Ispra. AUTOMATIC SCANNER DEVICE FOR THE DETERMINATION OF C¹⁴ ON PAPER CHROMATOGRAMS. M. Dubini and R. Fanteschi. May 1960. 13p.

An apparatus able to detect and record the activity from C¹⁴ labelled compounds on chromatographic paper strips is described. The least detectable activity is 4 \times 10⁻⁴ μ c. For activities ranging from 4 \times 10⁻⁴ to 6 \times 10⁻² μ c a relation

was found between the activity of the spots and the area of the corresponding peaks on the recording paper. (auth)

18733 HW-63047

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

METABOLISM OF Zn^{65} IN THE RAT—CHRONIC ADMINISTRATION STUDIES AND AGE EFFECTS. J. E. Ballou. Jan. 25, 1960. 23p. Contract AT(45-1)-1350. OTS.

Analysis of daily excretion during and following chronic feeding of Zn^{65} indicated approximately 50 to 60 per cent of the ingested isotope was absorbed from the gastrointestinal tract. Tissue retention of Zn^{65} deposited during chronic exposure was nearly the same as that found earlier in single administration studies. This agreement of results further supports earlier estimates of the hazard of Zn^{65} . The relatively high concentration and continued accumulation of Zn^{65} in bone and prostate gland throughout the feeding period suggested these organs as the critical organs for MPC calculations. Accumulation in the total body appears to be critical, however, due to the greater absorption of the decay energy in the larger organism and the lower permissible dose rate recommended for total body irradiation. The MPC calculated employing total body as critical organ was $3 \times 10^{-3} \mu\text{c/ml}$, using prostate the value was $3 \times 10^{-3} \mu\text{c/ml}$ and for bone a value of $1.4 \times 10^{-2} \mu\text{c/ml}$ was obtained. Twenty-four hour retention of gavage fed Zn^{65} by immature rats was as much as 5.5 times that of the adult. Absorption after weaning dropped abruptly to the adult level. Fetal tissue concentrations of Zn^{65} generally exceeded those of the dam fed during pregnancy; however, total Zn^{65} in the dam was greater than that in the total litter. Some suggestion of longer retention in the litter was found over a seven day retention period after Zn^{65} feeding was discontinued. (auth)

18734 HW-63643

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

QUARTERLY PROGRESS REPORT ON RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF RADIOLOGICAL SCIENCES, OCTOBER–DECEMBER, 1959. Jan. 25, 1960. 37p. Contract AT(45-1)-1350. OTS.

Passage through a bed of aluminum turnings lowered the concentration of radiophosphorus in reactor effluent water. No difference in the mortality rate was observed in experimental and control groups of rainbow trout given intramuscular injections of strontium-90–yttrium-90, but gastrointestinal damage resulted when trout were fed the same levels of strontium-90–yttrium-90. Progress is reported in studies on the transfer of strontium-85 across gill membranes in fish; the effects of deposited phosphorus-32 on survival and reproduction in fish; the biological effects of the chronic ingestion of small amounts of iodine-131 in swine; the effects of the chronic ingestion of small amounts of strontium-90 by swine on the blood picture of the offspring; the distribution of phosphorus-32 in the tissues of mice as demonstrated by counting with the whole-body mouse counter; the absorption and metabolism of plutonium in rats and swine in which a definite relationship was shown between body burden of plutonium and survival time following irradiation; the metabolism of strontium-90 and calcium-45 in rats; the pathology of gastrointestinal radiation injury and the use of polyvinylpyrrolidone labeled with iodine-131 as a diagnostic aid in the estimation of intestinal radiation injury; the evaluation of hazards from inhaled plutonium oxide; the effects of x radiation on the permeability of yeast cells; the radiobiological monitoring of the

Columbia River and environs; and the uptake of strontium-90 and cesium-137 by plants from contaminated soils. Phosphorescent zinc sulfide was used as a tracer in studies on the effects of meteorological conditions on the diffusion of particulate matter. A new system was developed for reading the amount of zinc sulfide. An analysis was completed on the data from 169 subjects given routine examinations in the Shielded Personnel Monitoring Station. Results for potassium and cesium were similar to those obtained with other whole-body counters. Investigations were made of the quantities of zinc-65 in human subjects, water, and foodstuffs and the route of transfer of zinc-65 to humans. It was found that zinc-65 in oysters and other sea food may be responsible for occasional high body burdens found in people. Investigations of techniques and experimental instrument development work were continued during the period. Problems involved in neutron dosimetry and field and personnel monitoring were investigated. Studies were continued on the deposition of particles on duct walls. Results indicate the importance of the velocity of air through the duct and of the particle diameter. (For preceding period see HW-62638.) (C.H.)

18735 NP-8740

Chicago. Univ. Air Force Radiation Lab.

QUARTERLY PROGRESS REPORT NO. 35. Apr. 15, 1960. 168p. Contract AF41(657)-252.

The influence of radioprotective agents was found to decrease (<25%) the reduced glutathione levels of some tissues of rats and mice. The effect of various chemical compounds on the nitrogen mustard-induced changes in enzyme activities of certain tissues of rats was studied. The results of rare earth oxide toxicity tests on rats indicated that the LD_{50} values for rare oxides exceeded 1000 mg/kg when they are given orally or intraperitoneally to rats. The LD_{50} values of several rare earth nitrates were determined to be between 250 and 300 mg/kg. Measurements were made of the influence of 1000 mg/kg of various rare earth oxides on the mortality and survival time of rats given 775 r of x rays simultaneously. Measurements of the *in vitro* effects of three salts of dithiocarbamic acid and bis(dimethyldithiocarbamyl)disulfide on the oxidation of alpha-ketoglutarate and alpha-ketoglutaric acid by rat liver showed that all of these compounds caused 50% inhibition of the reaction at molar concentrations between 1×10^{-4} and 1×10^{-5} M. Of forty-seven chemical compounds tested for protective effects against radiation lethality in mice, significant radioprotective effects were obtained with α -phenyl- β , β -dimethylaminoethylisothiuronium sulfate, tris(2-chloro-2-nitro-1-butyl)phosphate, and N, N'-dibenzylethylene diamine. Pre-irradiation administration of serotonin creatinine sulfate, 10 to 20 min prior to irradiation, was found to be most effective in preventing radiation lethality and weight loss in mice. Post-irradiation administration of serotonin was ineffective in preventing radiation lethality or weight loss. The role of steric and electronic factors in the SN_2 reactivity of 2,2,3-trimethylaziridine was elucidated, employing a spectrophotometric technique. A method for estimating the *in vivo* detoxification of 2-aminoethylisothiuronium dichloride in mice is presented. Polarographic measurements failed to show that serotonin, glyconitrile, or malononitrile reduce the oxygen tension of tissues; p-aminopropiophenone showed a probable decrease. The effect of starved mice rapidly losing the ability to control body temperature was counteracted by exposure to more than 600 r. Radioprotective drug administrations revealed a loss of temperature control. The effects of fractionation, protraction, and radioprotective agents on the residual injury following radiation exposure

were studied. Histopathological examinations were made of tissues of male mice exposed to chronic fractionated doses of fast neutron irradiation at dosage levels of 19 to 737 rep. (C.J.G.)

18736 NYO-9205

Columbia Univ., New York. Radiological Research Lab. ANNUAL REPORT ON RESEARCH PROJECT. July 1, 1960. 160p. Contract AT-30-1-GEN-70. OTS.

Progress is reported in the development of procedures for the determination of the dose of ionizing radiation at any desired point or region in a biological system in terms of the energy absorbed per gram of tissue. Procedures and instruments are described for the measurement of tissue dose of fast and slow neutrons, high-energy particles, beta particles, the measurement of the energy loss of alpha particles, measurement of beta-ray dose employing gas multiplication, and the measurement of tissue dose in brain tumors containing boron and irradiated with slow neutrons. Proportional and Geiger-Mueller counters with tissue equivalent walls were developed. Results are reported from a number of measurements of absorbed dose. A tissue equivalent ionization chamber for radiation measurements in outer space was built and tested. Progress is reported in studies on the mechanism of spontaneous and radioinduced mutations in bacteria; the effect of colony size on radiosensitivity of *Escherichia coli*; survival curves of HeLa cells irradiated on glass and plastic; the effect of temperature on the spontaneous mutation rate and longevity in *Drosophila melanogaster*; the response of carcinoma in mice to low doses of x radiation; and a series of studies on the biological effects of radiation in mice and rats. Training programs are outlined and a list of publications during the period is included. (C.H.)

18737 ORINS-34

Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. OAK RIDGE INSTITUTE OF NUCLEAR STUDIES MEDICAL DIVISION REPORT FOR 1959. 87p. Contract AT-40-1-GEN-33. OTS.

Studies associated with whole-body irradiation followed by attempts at bone-marrow grafts in acute leukemia patients were continued. Data were compared with results reported by other workers. Results are reported from studies on the effects of both whole-body and local-port irradiation on various hematological diseases, other clinical syndromes, and normal hematopoietic tissues. It was demonstrated that large doses of whole-body irradiation alone can produce remissions in leukemia. Results are reported on a group of patients who received autologous bone marrow grafts after a single large dose of nitrogen mustard. Clinical results are reported on a group of eleven patients with acute or subacute leukemia given a single large dose of whole-body irradiation, varying from 200 r to more than 900 r, followed by intravenously administered bone marrow from homologous donors cross matched for the usual major blood types. A summary is included of current impressions of the treatment of leukemia by irradiation and marrow grafting. Pathological changes following whole-body irradiation are discussed. Results are reported from clinical studies on 8 men exposed to whole-body radiation 9 months previously during the Y-12 accident. A comparison is made in data on the Y-12 patients and data on the Yugoslavian accident victims. Procedures for the recovery of amino acids from solutions are discussed and data are tabulated on daily variation in levels of urinary amino acids, and the effects of whole-body irradiation or nitrogen mustard on urinary excretion of amino acids. Research with internal isotopes was continued and progress is reported in the development of scanning equip-

ment and in interpretation of results. Teletherapy treatments were given to 64 patients suffering from lymphomas of several types. Summaries are included of experimental work on the properties and localization by linear scanning of calcium-47 in rats; the distribution of radioactive colloidal yttrium in rats; selective irradiation by the intralymphatic injection of radioactive preparations; metabolism of rare earths; and liver-liquid response to radiocerium. The design and calibration are described of a whole-body irradiator employing 8 cesium-137 teletherapy machines. New designs and design modifications are described for equipment for scanning and radiation therapy. A training program is outlined. A list of publications during the period is included. (C.H.)

18738 TID-5764

Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

BLAST BIOLOGY. Technical Progress Report. Clayton S. White and Donald R. Richmond. Sept. 18, 1959. 90p. Contract AT(29-1)-1242. OTS.

Experimental data regarding the biologic consequences of exposure to several environmental variations associated with actual and simulated explosive detonations were reviewed. Blast biology is discussed relative to primary, secondary, tertiary, and miscellaneous blast effects as those attributable, respectively, to variations in environmental pressure, trauma from blast-produced missiles (both penetrating and nonpenetrating), the consequences of physical displacement of biological targets by blast-produced winds, and hazards due to ground shock, dust, and thermal phenomena not caused by thermal radiation per se. Primary blast effects were considered, noting physical-biophysical factors contributing to the observed pathophysiology. A simple hydrostatic model was utilized diagrammatically in pointing out possible etiologic mechanisms. The gross biologic response to single, "fast"-rising overpressures were described as was the tolerance of mice, rats, guinea pigs, and rabbits to "long"-duration pressure pulses rising "rapidly" in single and double steps. Data regarding biological response to "slowly" rising overpressures of "long" duration are discussed. Attention was called to the similarities under certain circumstances between thoracic trauma from nonpenetrating missiles and that noted from air blast. The association between air emboli, increase in lung weight (hemorrhage and edema), and mortality was discussed. Data relevant to the clinical symptoms and therapy of blast injury are presented. The relation of blast hazards to nuclear explosions was assessed and one approach to predicting the maximal potential casualties from blast phenomena is presented making use of arbitrary and tentative criteria. (auth)

18739 TID-6160

Iowa. State Univ., Iowa City.

THE CHEMISTRY OF BORON IN PLANTS. Technical Progress Report. [n.d.] 7p. Project No. 9. Contract AT(11-1)-59. OTS.

Preliminary results are reported from studies of photosynthesis in boron-deficient plants. A method was developed for the determination of borate by paper chromatography. (C.H.)

18740 TID-6183

Worcester Foundation for Experimental Biology, Shrewsbury, Mass.

REPORT OF PROGRESS [FOR] PERIOD COVERED: JULY 1, 1959 TO MAY 31, 1960. Gregory Pincus. June 3, 1960. 16p. Contract AT(30-1)-918. OTS.

The biosynthesis and metabolic pathways are reported

for a number of carbon-14 and tritium labeled steroids. Measurements were made of urinary androgen levels before and after the surgical removal of tumors of the testes and adrenals. Metabolic activity was demonstrated by the synthesis of steroids by muscle and tumor slices in an environment containing carbon-14 or tritium. From the results reported it is concluded that both cholesterol and pregnenolone may be considered precursors of dehydroepiandrosterone. A mechanism of ACTH action is suggested. Data are tabulated from a study of the influence of steroids on irradiation injury in male mice. Under the conditions of the study only estradiol was found to give significant protection. (C.H.)

18741 UR-553

Rochester, N. Y. Univ. Atomic Energy Project. A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE TEMPERATURE RESPONSE OF PIG SKIN EXPOSED TO THERMAL RADIATION. Thomas P. Davis. June 10, 1959. 271p. Contract W-7401-eng-49. OTS.

Estimates indicate that first degree burns on the bare skin will be sustained 30 miles from a 10 megaton nuclear blast. Results are reported from a theoretical and experimental investigation of the temperature response of pig skin exposed to thermal radiation. While the study deals with radiant energy heating of skin, it is concluded that results may be applied to other modes of energy input. Methods were developed for the comparison of theoretical predictions with experimental results. An attempt is made to simplify the basic equation of heat conduction. Results are presented together with an evaluation of the constants of skin, whenever possible. It was shown that the absorption pattern of radiation in skin may be determined directly by temperature measurements. 50 references. (C.H.)

18742 USNRDL-TR-374

Naval Radiological Defense Lab., San Francisco. INTESTINAL ELECTROLYTE ABSORPTION BY THE PARALLEL DETERMINATION OF UNIDIRECTIONAL SODIUM AND WATER TRANSFERS. B. E. Vaughan. Oct. 12, 1959. 46p.

Plasma-to-lumen, lumen-to-plasma, and net transfer rates for both sodium and water have been determined on dogs with Thiry-Vella loops, using a single transit perfusion. The net and lumen-to-plasma transfer rates of sodium are proportional to the concentration of sodium in the intestinal perfusate; net absorption of sodium ion occurs at all luminal sodium concentrations above 32 mEq/l. Water net transfer rate is inversely proportional to luminal osmolality; net absorption of water takes place at all luminal osmolalities up to 400 mOsmol/l. Hence, water must be actively transported and not transported exclusively as a passive osmotic consequence of sodium movement. Lumen-to-plasma water transfer rates do not show a clear-cut osmotic dependency, owing to correlated sodium and water transfers. The regression slope of sodium on water transfer rates indicates the one-way transfer of an extremely dilute solution (42 mEq/11.), and this is true regardless of the composition of solution in the lumen. Such a phenomenon is a clear description of a fluid circuit mechanism. (auth)

18743

A SOLUTION OF GLUCOSE RECEIVING A STERILIZING DOSE OF γ RAYS HAS AN ANTIRACHITIC ACTIVITY OF COMPLEX STRUCTURE. Paul Fournier and Marguerite Forestier (Laboratoire de Physiologie de la Nutrition, Paris). Compt. rend. 250, 3728-30(1960) May 30. (In French)

A solution of glucose treated with γ rays at doses used for the sterilization of foods has an antirachitic activity of complex structure. Under the effect of the ingestion of this solution, the rat absorbs and retains most of the calcium, while the blood and osseous signs of rachitism disappear. (tr-auth)

18744

STUDIES WITH PURPLE ADENINE MUTANTS IN NEURO-SPORA CRASSA. IV. LACK OF COMPLEMENTATION BETWEEN DIFFERENT ad-3A MUTANTS IN HETEROKARYONS AND PSEUDOWILD TYPES. Frederick J. de Serres (Oak Ridge National Lab., Tenn.). Genetics 45, 555-66(1960) May.

Heterokaryon tests on a series of 13 genetically unmarked ad-3A strains of independent origin showed no evidence for interallelic complementation in any pairwise combination. The possibility that such negative results might be inconclusive was investigated with forced heterokaryon tests on genetically marked strains. No evidence for interallelic complementation in any pairwise combination of these mutants was found in forced heterokaryons grown on unsupplemented medium or medium supplemented with suboptimal levels of adenine. The recovery of true wild type progeny from crosses of different ad-3A mutants with a marked strain of mutant A2 suggest that the ad-3A region consists of an undetermined number of mutable sites, but the lack of asymmetry in marker segregation among the adenine-independent progeny did not permit an ordering of the mutants with reference to mutant A2 and the adjacent markers hist-2 and nic-2. The failure to recover pseudowild type progeny involving both ad-3A parental chromosomes from the fertile intercrossovers provides further evidence for the absence of interallelic complementation in these combinations. The present experiments firmly substantiate the original interpretation of the negative heterokaryon tests with genetically unmarked but isogenic ad-3 mutants: that, under the experimental conditions used, such results are significant and provide evidence for the absence of complementation. The present data are consistent with the ad-3A locus being a one-cistron locus with an undetermined number of recombinable, mutable sites. (auth)

18745

SOME PHYSICAL AND PHYSIOLOGICAL FACTORS CONTROLLING THE FATE OF INHALED SUBSTANCES. I. DEPOSITION. P. E. Morrow (Univ. of Rochester, N. Y.). Health Phys. 2, 366-78(1960) May.

Various physical and physiological factors are discussed in terms of their effect on aerosol stability and especially as they are related to the deposition of dusts in the respiratory tract of man. Although a unifying formulation of these factors is not available, nor attempted herein, efforts are made to indicate the nature of the more important factors and the circumstances in which they might be most significant. (auth)

18746

SOME PHYSICAL AND PHYSIOLOGICAL FACTORS CONTROLLING THE FATE OF INHALED SUBSTANCES. II. RETENTION. L. J. Casarett (Univ. of Rochester, N. Y.). Health Phys. 2, 379-86(1960) May.

Some of the mechanisms by which particles are cleared from the lung are discussed. Emphasis has been placed on relatively insoluble particles deposited in alveoli. The fundamental mechanisms of clearance are discussed, with some emphasis on those aspects which are pertinent to the calculations of the radiation dosage to the lung as usually performed. (auth)

18747

INVESTIGATIONS ON BABIES AND EXPECTANT MOTHERS WITH REDUCED DOSES OF RADIOISOTOPES. Fazle Hosain (Saha Inst. of Nuclear Physics, Calcutta). *Indian J. Radiol.* **14**, 1-5(1960) Feb. (In English)

Sensitive instruments, low-level counting devices, and short-lived isotopes are recommended for diagnostic tracer studies with radioisotopes in babies and expectant mothers. Results are tabulated from studies using iodine-131 and iron-59. (C.H.)

18748

DETERMINATION OF A LARGE NUMBER OF RADIOACTIVE MATERIALS IN THE BODY ORGANS ON THE BASIS OF THEIR EXCRETIONS. T. Trnovec (Inst. of Industrial Hygiene and Vocational Medicine, Bratislava, Czechoslovakia). *Pracovní lékařství* **11**, 206-15(1959). (In Czech)

The determination of 26 radioisotopes deposited in certain critical organs of the body by excretion analysis is reviewed on the basis of 98 references. Methods of determination based on (a.) the radioactive material present in the organs; (b.) aerosols and lung excretions; (c.) direct excretions from the organs; and (d.) radiation from material obtained by biopsy are described in detail. Special attention is given to the equations of W. H. Langham, W. P. Norris, R. D. Ray, W. E. Siri et al., expressing the excretion of a biological system as an exponential function and determining the body burden following a single acute exposure or a known variable chronic exposure. A comprehensive table gives a detailed compilation of data referring to these 26 isotopes, listing the critical organ in which each of them is deposited, the biological half-life, the urine-feces ratio, type of radiochemical analysis, etc., correlating this information to the needs and the facilities of Czech laboratories. The technique used at LASL for determining personnel exposure (AECD-4075) is discussed in detail. (TTT)

18749

DISTRIBUTION IN BLOOD AND EXCRETION OF Zn^{65} IN MAN. Frank A. Graig and Edward Siegel (Montefiore Hospital, New York). *Proc. Soc. Exptl. Biol. Med.* **104**, 391-4 (1960) July.

Distribution and concentration of Zn^{65} in whole blood, plasma, and red cells were studied following intravenous infusion. Analyses of concentration curves suggest that they can be resolved into exponential components. Plasma Zn^{65} becomes protein-bound by 3 hrs following its injection and remains non-dialyzable at least up to 40 days. Red cell Zn^{65} becomes protein-bound and cannot be removed by dialysis from the hemoglobin solution. Excretion of Zn^{65} in the urine occurs presumably as an inorganic compound. Fecal excretion of Zn^{65} is variable and may depend on tissue saturation. The possibility exists that prolonged diarrhea may lead to zinc depletion. (auth)

18750

International Atomic Energy Agency, Vienna.
APPLICATION OF HIGH ENERGY RADIATIONS IN THERAPY. Bibliographical Series, No. 1. 1960. 86p. \$1.00.

This bibliography contains 730 references to the application of high-energy radiations in therapy. Radioisotope teletherapy units and supervoltage therapy with accelerators are emphasized. General reviews and articles of historical interest are included. (C.H.)

18751

ADJUSTABLE BEAM LIMITING DIAPHRAGM FOR RADIATION THERAPY. (to Picker X-Ray Corp., Waite Manufacturing Div., Inc.). British Patent 832,373. Apr. 6, 1960.

An adjustable beam limiting diaphragm for high-energy rays emanating from a source adapted for radiation therapy is presented. The diaphragm plate sets are arranged in pile formation of constant length along the beam, each being composed of an L-shaped ray absorbing movable plate. Operating mechanisms are connected to the diaphragm plates for adjusting them relative to each other. (W.L.H.)

Biochemistry, Nutrition, and Toxicology

18752

WHOLE-BODY MEASUREMENT OF RADIOACTIVITY AS A MEANS OF FOLLOWING IN VIVO THE DEGRADATION OF I^{131} -LABELED PROTEINS IN MICE. Geronimo Terres, W. L. Hughes, and W. Wolins (Brookhaven National Lab., Upton, N. Y.). *Am. J. Physiol.* **198**, 1355-60(1960) June.

Mice were injected with I^{131} -labeled human or bovine serum albumin and determinations made of the rate of loss of radioactivity from the whole body by *in vivo* counting, from the blood, and from the total trichloroacetic acid precipitable mouse proteins following homogenization. Measurements by each method made more than 8 hours post-injection gave the same half life (14.5 ± 0.5 hr) for I^{131} bovine serum albumin (I^{131} BSA) when the level of circulating iodide was sufficient to prevent thyroidal accumulation (I^{131} HSA had a half time of 21 hr). The variations observed between the methods in the first 24 hours can be explained in terms of times required for the several compartments to reach secular equilibrium, and therefore whole-body measurements *in vivo* can be safely used to measure the rate of degradation of this protein when allowance is made for these factors. (auth)

18753

MEDICAL REPORT ON COMPARATIVE HISTOPATHOLOGY OF EXPERIMENTAL ACUTE POISONING BY SALTS OF COBALT, NICKEL, AND URANIUM. A. Zarone (Università, Naples). *Folia Med. (Naples)* **43**, 267-75(1960) Mar. (In Italian)

In a series of nine guinea-pigs, subdivided into three groups, cobalt, nickel, and uranium salt poisoning, respectively, was determined. Equimolar doses were given, in order that a comparison of the toxic effects by the three compounds might be possible. (auth)

18754

PLUTONIUM ACCUMULATION FROM LONG-TERM OCCUPATIONAL EXPOSURE. H. Foreman, W. Moss, and W. Langham (Los Alamos Scientific Lab., N. Mex.). *Health Phys.* **2**, 326-33(1960) May.

Analyses of tissue aliquots from a plutonium process operator, who was exposed to Pu^{239} largely via chronic low-level inhalation for approximately 6 out of 11.5 years of employment, showed that he had accumulated a body burden of approximately 0.018 μ c. Estimations of his body burden from his urine assay record ranged from 0.019 to 0.034 μ c. The highest plutonium concentration was found in pulmonary lymph nodes, followed by liver, lungs, and bone. Some implications of these findings to chronic low-level inhalation exposures and to estimation of body burden from urine assays are discussed. (auth)

18755

THE DISTRIBUTION AND EXCRETION OF THALLIUM-204 IN THE RAT, WITH SUGGESTED MPC'S AND A BIO-ASSAY PROCEDURE. R. Lie, R. G. Thomas, and J. K. Scott (Univ. of Rochester, N. Y.). *Health Phys.* **2**, 334-40 (1960) May.

The distribution and excretion of thallium in the rat were studied following injection of Tl^{204} by six routes: intramuscular, intraperitoneal, intratracheal, intravenous, oral, and subcutaneous. In all cases absorption is rapid and distribution diffuse with comparatively large quantities found in the kidneys. It is assumed that thallium is generally incorporated into the intracellular fluids. There is no day to day variation in relative organ thallium content with the exception of hair in which there is an actual build-up of thallium with time. Any organ except hair may therefore be said to have the same biological half-time as the body burden (3.3 days) which follows a single exponential function extrapolating to 100 per cent at zero time. Excretion assumes the same pattern after all routes of injection with some minor exceptions. There is a fecal to urinary ratio of between 2 and 5, a greater rate of decrease in thallium content being found in the urine than in the feces. A maximum permissible body burden and maximum permissible concentrations for air and water were calculated for Tl^{204} with kidney as critical organ. Assuming body burden equilibrium at about 30 days exposure on an industrial routine, a suitable method for bio-assay was suggested. (auth)

18756

STRUCTURAL IMPLICATIONS IN CESIUM SORPTION.

T. Tamura and D. G. Jacobs (Oak Ridge National Lab., Tenn.). *Health Phys.* 2, 391-8(1960) May.

The effectiveness of the local Conasauga shale for removing cesium from radioactive waste solutions is discussed. Illite, which is present in the shale, has a particularly high affinity for cesium. The importance of the c-axis dimension of the 2:1 layer lattice clays was demonstrated by using synthetic micas and selected cation treatment. The beneficial role of potassium in the mica and illite is primarily because this element can induce and maintain collapse of the c-axis. Ion exchange dimension in predicting the cesium sorption behavior of clays. The potassium treatment and oven-drying of clays followed by cesium sorption may be used to differentiate montmorillonite from vermiculite. The importance of the findings in terms of weathering and diagenetic processes involving clays is discussed. (auth)

18757

NEUTRON ACTIVATION ANALYSIS OF MERCURY, COPPER AND ARSENIC IN MARINE ORGANISMS. Hiroshi Hamaguchi, Rokuro Kuroda, and Kyoichi Hosohara (Tokyo Univ. of Education and Ehime Univ., [Japan]). *J. Atomic Energy Soc. Japan* 2, 317-20(1960) June. (In Japanese)

The mercury, copper, and arsenic contents of some marine organisms were determined by neutron activation. The irradiations were carried out in JRR-1 reactor, with neutron fluxes of about 3×10^{11} n/cm²/sec, and the irradiation lasted 2 to 3 days (intermittently, 5 hr each day). After cooling for 2 days the sample was dissolved by treating with nitric-sulfuric acid and potassium permanganate in the presence of carriers. From the clear solution the mixed sulfides were separated from the bulk of the contaminating activities, and the arsenic and copper were dissolved by treating successively with hot 6 N ammonium polysulfide and 6 N nitric acid, leaving the mercury sulfide unattacked. Further decontamination chemistry was carried out for each element. The amount of the element in the marine organisms was then determined by comparing Hg^{203} , Cu^{64} , and As^{76} β activities isolated from the sample with those from the monitor. The mean chemical yield was 40, 65, and 30% for mercury, copper, and arsenic, respectively, and the sensitivity of the method was Hg 1.5 μ g, Cu 0.03 μ g, and As 0.04 μ g. The method makes it possible to minimize loss and contamination, the greatest obstacles in other

analytical techniques for the determination of extremely minute amounts of these elements. (auth)

18758

THE SORPTION OF H_2O AND D_2O VAPORS BY LYOPHILIZED β -LACTOGLOBULIN AND THE DEUTERIUM-EXCHANGE EFFECT. Lloyd H. Reyerson and Wasyli S. Hnojewyj (Univ. of Minnesota, Minneapolis). *J. Phys. Chem.* 64, 811-15(1960) June.

Data are reported for the sorption of H_2O and D_2O vapors by dry, lyophilized β -lactoglobulin at 17 and 27°C. The amounts adsorbed and the calculated differential heats of sorption for D_2O turn out to be higher than for H_2O under the same conditions. A definite exchange effect was observed which indicated that the labile hydrogens of the dry protein were readily replaced by deuterium atoms during the sorption of D_2O molecules. This exchange reverses itself when H_2O is sorbed on the protein-containing "labile deuterium" atoms. (auth)

Fallout and Ecology

18759 A/AC.82/G/R.200

Akademiya Nauk S.S.S.R.

UPTAKE OF RADIOACTIVE STRONTIUM BY PLANTS AND ITS ACCUMULATION IN VARIOUS AGRICULTURAL CROPS. V. M. Klechkovskii (Klechkovsky) and I. B. Gulyakin. 1958. 27p.

A study was made of various factors influencing the uptake of radiostrontium from soil by plants and its accumulation in agricultural crops. Data are tabulated. The results of the experiments show that both the biological characteristics of plants and the properties of the soil from which the plant takes up radiostrontium influence the amount accumulated in the crop and the content per unit of dry substance. (C.H.)

18760 CF-59-9-74

Oak Ridge National Lab., Tenn.

SUMMARY REPORT OF HRP IN-PILE CORROSION TEST AUTOCLAVE L53T-132. R. J. Davis, K. S. Warren, and G. H. Jenks. Sept. 23, 1959. 42p. Contract [W-7405-ENG-26]. OTS.

Experiment L53T-132 employed a titanium autoclave to expose three Zircaloy-2 coupons and three titanium coupons in an experiment designed to provide information on the transport of Zircaloy-2 corrosion products in autoclaves and on the effects, if any, of such a transport on the radiation corrosion of Zircaloy-2. The data indicate that some of the Zircaloy-2 corrosion scales were transferred to titanium surfaces. The loose scale on the Zircaloy-2 specimens was only 0.7% uranium and contained only 1 μ g/cm² of uranium. The underlying film and metal surface contained 22 μ g/cm² of uranium. The Zircaloy-2 corrosion rates in this test of a D_2O solution were somewhat higher at given power densities than those in previous 280°C tests of all-Zircaloy-2 systems with similar light-water solutions. Radiochemical analyses of scale and surface samples indicated that little Cs^{137} was included in the films and scales. Essentially all the Ru^{108} and much of the Pu^{239} was deposited on the titanium surfaces. (auth)

18761 TID-6153

Michigan. Univ., Ann Arbor.

UPTAKE, TRANSPORT, AND EFFECTS OF RADIOACTIVE MATERIALS IN AQUATIC ECOSYSTEMS. Progress Report. [1959?] 5p. Project 02934. Contract AT(11-1)-781. OTS.

Preliminary studies are reported in an investigation of bacterial metabolism in natural water and the transport of

radioactive substances in an aquatic community. No technical data are included. (C.H.)

18762

NEW DATA ON C^{14} CONCENTRATION IN ATMOSPHERE. Yu. V. Sivintsev. *Atomnaya Energ.* **8**, 573-5(1960) June. (In Russian)

An analysis of recent data shows that the total C^{14} concentration is about 25×10^{27} atoms and in human tissues it is lagging only 1.1 to 1.8 years behind the atmospheric content. (R.V.J.)

18763

AN APPROACH TO THE QUESTION OF COMPUTING DOSES AND EFFECTS FROM FALL-OUT. Bo Lindell (Inst. of Radiophysics, Stockholm). *Health Phys.* **2**, 341-65(1960) May.

Estimates of the possible number of injuries that might occur as a result of fall-out from nuclear weapons tests are frequently presented in scientific literature. In most cases the emphasis is put on the numerical result, which invites criticism, since the validity of certain assumptions, especially those regarding the biological effect of small doses cannot be proved. The great number of uncertainties involved in such estimations leads many authors to feel that rough approximations are justified. However, a number of important parameters are thus often overlooked, and certain assumptions necessary to the results are accepted without being recognized. This paper is an approach to the question of the parameters and assumptions that must be taken into account in such calculations; parameters and assumptions which would in fact influence the final considerations of the actual effects of radiation on a population. Provided that the physical fall-out mechanism is known, it is possible to calculate various organ doses that might be relevant to the biological effects. Calculations of the dose in the gonads and the bone marrow were made, with special regard to the two extreme assumptions of biological dose effect relation, namely a linear relation without threshold, and a threshold relation. This survey of the parameters and assumptions leads to some interesting results; e.g., that there are indications that the per capita mean marrow dose in a population may be relatively little affected by the actual retention mechanism of Sr^{90} in bone. (auth)

18764

RADIOSTRONTIUM AND RADIOCAESIUM IN MILK DURING 1959. W. Anderson, L. K. Burton, and J. O. Crookall (Royal Cancer Hospital, London). *Nature* **187**, 108-10(1960) July 9.

Data are presented on the levels of strontium-90, strontium-89, and cesium-137 in milk samples collected in Wales throughout 1959. Levels of activity rose during April, May, and June. The increase is attributed to an increased rate of fall-out as well as an increase in the soil reservoir of fission products. (C.H.)

18765

RADIOACTIVITY OF SOILS, PLANTS AND BONES. Ernest Marsden (Dominion Physical Lab., N. Z.). *Nature* **187**, 192-5(1960) July 16.

Data are reviewed on the radioactivity of samples of soils, plants, and bones collected at various locations throughout the world. The effects of continuous high levels of radioactivity on the population of the regions are discussed. Evidence is presented which indicated low fertility in areas of high local radioactivity. The question is raised of the selective breeding of radiation-resistant types. (C.H.)

18766

ALPHA ACTIVITY OF CERTAIN BOTANICAL MATERIALS. W. V. Mayneord, R. C. Turner, and J. M. Radley (Royal Cancer Hospital, London). *Nature* **187**, 208-11(1960) July 16.

Results are tabulated from measurements of alpha radioactivity in a number of plants and soil samples collected in Great Britain and Central Africa. Some of the plants are used directly as human foods while others, such as grasses, are used as the principal food of animals, which in turn become human food. Measurements were made of total alpha activity, the relative contributions made by the uranium and the thorium series, and the precise identification of nuclides present. A very wide range of natural alpha activities was found in vegetation compared with that in the corresponding specimens of soil. (C.H.)

18767

LEAD-210 AND POLONIUM-210 IN GRASS. C. R. Hill (Royal Cancer Hospital, London). *Nature* **187**, 211-12(1960) July 16.

Evidence is presented that suggests that a large part of the alpha activity observed in certain samples of grass may originate as a decay product of atmospheric radon which is deposited onto the grass by rainfall. Results are reported from measurements of alpha activity of samples of grass and soil collected in the southern part of Great Britain. Measurements were also made on tissues from lambs from the same region. Polonium-210 was found concentrated in the kidney. Observations of the decay of total alpha activity indicated that polonium-210 occurs in the absence of lead-210. (C.H.)

18768

RELATIVE AVAILABILITY OF SOME STRONTIUM-90 COMPOUNDS IN SOIL. R. L. Uhler and F. P. Hungate (General Electric Co., Richland, Wash.). *Nature* **187**, 252-3(1960) July 16.

Assessment of contamination of man's food chain by strontium-90 through plants is complicated by variables in the plant's source of this isotope. The content of strontium-90 in plants from fall-out may be influenced by foliar absorption, stem-base sorption, and the vertical distribution of strontium-90 in the soil profile. Results are reported from a study of possible means for depressing the uptake of strontium-90 from contaminated soils by plants. (C.H.)

Radiation Effects on Living Tissues

18769 AD-228529

Westinghouse Electric Corp. Research Labs., Pittsburgh. THERMOELECTRICITY QUARTERLY PROGRESS REPORT NO. 3. Aug. 13, 1959. 222p. Contract NOBS-77043.

Progress is reported in studies on the development of refractory compounds for use in high-temperature work. Several materials indicate very definite possibilities for use in the temperature range from 1000 to 1500°K. The phase diagram studies on GeTe have led to a better understanding of this system and also of (Ge-Bi)Te. As crystal perfection is not felt to be so important at high temperature, some materials are being fabricated using pressing and sintering techniques. One of these, PbTe, has shown itself to be superior to either the grown or cast material. A measure is given of the upper limit of the thermal efficiency of a thermoelectric device using presently available materials. It should be noted that this number has in-

creased from 16.2 to 17.1% on the n-leg and from 14.4 to 15.5 on the p-leg. (auth)

18770 AD-232881

Continental Can Co., Inc., Chicago.

COMPARATIVE RESISTANCE OF STRAINS OF CLOSTRIDIUM BOTULINUM TO IONIZING RADIATION. Report No. 4 (Progress) [for] May 11, 1959 to June 10, 1959. J. M. Heinen. 18p. Project No. 7-84-01-002. Contract DA-19-129-QM-1214.

Progress is reported in studies on the radiosensitivity of spores of various strains of Clostridium botulinum. Procedures were developed for the production of high spore yields. (C.H.)

18771 AD-232882

Michigan State Univ., East Lansing.

INVESTIGATION OF PHYSIOLOGICAL FACTORS WHICH CONTRIBUTE TO THE RADIORESISTANCE OF SPORES OF CLOSTRIDIUM BOTULINUM. Report No. 7 (Progress) [for] May 9, 1959-July 8, 1959. Ralph N. Costilow. 7p. Project No. 7-84-01-002. Contract DA-19-129-QM-1177.

Progress is reported on the influence of different sporulation media on the irradiation resistance of spores of Cl. botulinum and on viability of irradiated spores in different diluents, at different temperatures for various periods of time. (auth)

18772 AF-SAM-60-12

Oak Ridge National Lab., Tenn.

LATE SOMATIC EFFECTS OF INTERNALLY DEPOSITED RADIOISOTOPES. T. T. Odell, Jr., and A. C. Upton. July 15, 1959. 19p.

The results of a number of studies are reviewed. It is concluded that the late pathologic effects of internally deposited radioisotopes are similar to those of external radiations and include the induction of degenerative changes, neoplasms, and shortening of the life span. The probability of the induction of these effects varies with the amount of radiation absorbed, the dose rate, the quality of the radiation (LET), the distribution of the absorbed dose in tissue, and the genetic and physiologic constitution of the organism irradiated. Consequently, the effects of radioisotopes vary greatly, depending on such factors as the physical half life and chemical nature of the isotope and of its decay products; the chemical and physical properties of the form in which the isotope is encountered; the route of entry of the isotope into the body; and the uptake, distribution, metabolism, and rate of elimination of the isotope from the body. Because of the great diversity among radioisotopes in these properties, a wide variety of effects was observed. In general, the most hazardous isotopes appear to be those with long half lives, energetic emissions, and a predilection to become localized in the skeleton. These attributes, characteristic of many fission products whose biologic effects have yet to be thoroughly evaluated, are also shared by radium, which was extensively studied in man and animals. One of the tasks of future research, therefore, will be the extension to other isotopes of the knowledge now available for radium. In addition, increasing efforts will be needed to elucidate the effects of small quantities of isotopes in the environment on man and his food chain. 115 references. (auth)

18773 AF-SAM-60-26

School of Aviation Medicine, Brooks AFB, Tex. and Texas Univ., Austin. Radiobiological Lab.

EFFECTS OF RARE-EARTH NITRATE AND OXIDE ON IRRADIATED AND NONIRRADIATED RATS. George S. Melville, Jr. and Robert W. Riess. Sept. 17, 1959. 11p.

Two salts of a rare-earth mixture were given to rats both intraperitoneally and subcutaneously. In addition, certain of the groups so treated received 800 r of gamma rays regardless of route of administration of the chemical. With or without irradiation, rare-earth nitrate was more damaging to the animals than rare-earth oxide. Animals which received the more soluble nitrate demonstrated diarrhea, anorexia, and fluffing. These symptoms, which were not seen in the rare-earth oxide animals, subsided in approximately 7 days. When given subcutaneously, the nitrate caused abscesses which healed in 30 days and the oxide caused nodules which disappeared slowly. Mortality was higher in the irradiated groups of animals. (auth)

18774 AF-SAM-60-43

Texas Univ., Austin. Radiobiological Lab. and School of Aviation Medicine, Brooks AFB, Tex.

THE EFFECT OF ACUTE DOSES OF NUCLEAR RADIATIONS ON THE PERIPHERAL BLOOD PICTURE OF THE MONKEY (MACACA MULATTA). Thomas P. Leffingwell, George S. Melville, Jr., and Quentin L. Hartwig. Nov. 30, 1959. 13p.

Male Macaca mulatta monkeys were exposed to three different doses of combined neutron and gamma radiations which derived from an uncontrolled nuclear reaction. Changes which were observed in the peripheral blood picture may be attributed solely to the effects of the ionizing radiations to the 1 percent confidence limit. Results, compared with those obtained by other investigators, show the hematologic effects of neutron-gamma exposure to be similar to those resulting from exposure to x radiation. (auth)

18775 CEA-Bib-6

France. Commissariat à l'Énergie Atomique, Paris.

Centre d'Etudes Nucleaires, Saclay.

RECUEIL BIBLIOGRAPHIQUE DES PRINCIPALES PUBLICATIONS RELATIVES A LA RADIOTOXICOLOGIE DU PLUTONIUM-239. BIBLIOGRAPHIE NO. 6. (Collection of Summaries of the Main Publications Dealing with the Radiotoxicology of Pu²³⁹. Bibliography No. 6). L. Roule. 1959. 75p.

A bibliography of the main publications relating to the radiotoxicology of plutonium-239 is presented. A brief historical review and over-all survey of biological and medical research on plutonium is followed by a study of the determination of plutonium in the organism and its excreta, in air, in water, and on the premises. The metabolism of plutonium and also the various parts of the organism in which it is deposited were the object of many studies, and from these were established the values of the maximum permissible concentrations in air and water, respectively, as well as the maximum permissible body burdens. The toxicity of plutonium in its acute and chronic effects, leading to cancerous lesions, is studied on the one hand, and on the other contamination of the skin, the gastrointestinal tract and the lungs, and the various treatments proposed. (auth)

18776 TID-5946

New York Univ., New York. Medical Center.

VASCULAR AND TISSUE ALTERATIONS INDUCED BY WHOLE BODY X-IRRADIATION. Progress Report, 1959-1960. Benjamin W. Zweifach and E. Kivv-Rosenberg. May 31, 1960. 6p. Contract AT(30-1)-1680. OTS.

Progress is reported in studies on the effects of 5-hydroxytryptamine on the lethal course of irradiation in rats; capillary resistance, blood coagulation time, and platelet count in irradiated rats; the effects of whole-body irradiation on the production of tissue damage in rabbits; and the effects of x irradiation on the level of substrate-

dependent dehydrogenase activity in homogenates of both unispermated and ispermated *Spisula* eggs. (C.H.)

18777 TID-6063

Massachusetts. General Hospital, Boston.

THE BIOLOGIC EFFECTS OF RADIATION ON THYROID TISSUE. Annual Progress Report for May 16, 1959 to May 15, 1960 and Renewal Application. Oliver Cope. June 17, 1960. 11p. Contract AT(30-1)-667. OTS.

Progress is reported in a study of the possible carcinogenic action of irradiation of the thyroid. A survey is underway on patients receiving radiotherapy for thyroid diseases during the past 20-year period. Possible leukemic and genetic effects will also be studied. Patients who have had therapeutic doses of I^{131} will also be followed. Data are also being accumulated on levels of radioactive iodine from fall-out in the thyroids of humans obtained at autopsy. (C.H.)

18778 TID-6156

Kansas. Univ., Lawrence.

IMMUNOCHEMICAL STUDIES OF RADIATION-INDUCED DAMAGE TO BIOLOGICAL SYSTEMS. Technical Progress Report No. 4 for May 16, 1959 through April 30, 1960. Charles A. Leone. May 1, 1960. 72p. Project No. 4. Contract AT(11-1)-83. OTS.

Progress is reported in studies on the effects of gamma radiation on the serological properties of lyophilized protein; the radiation-induced denaturation of ovalbumin; sedimentation studies of irradiated, lyophilized ovalbumin; the stability of irradiated ovalbumins; radiation injuries of molecules; the radiosensitivity of hemocyanins from crustaceans and arachnids; chromatographic studies on gamma-irradiated ovalbumin; and the responses of tobacco mosaic virus to gamma radiation. Manuscripts are included of papers accepted for publication during the period. (C.H.)

18779 JPRS-L-832-N

THE EFFECT OF IONIZING RADIATION ON DESCENDANTS. I. A. Piontkovskii (Piontkovskiy). Translated from *Patol. Fiziol. i Eksptl. Terap.* 3, No. 1, 12-20(1959). 17p. OTS.

Observations on 587 rats subjected to single doses of ionizing radiation on the 5th, 9th, 12th, and 18th days of antenatal life led to the conclusions that doses of 200 r of both x and gamma radiation, applied in a single dose, are capable of causing intrauterine death of either all, or a significant portion of the litter. Radiation exposure of the mother resulted in the offspring showing decreased viability, growth anomalies, a reduction in brain weight, structural peculiarities of the brain, and disturbances of the central nervous system resulting in changes in conditioned reflex. (C.H.)

18780

X-IRRADIATION LETHALITY AGGRAVATED BY SEXUAL ACTIVITY OF MALE MICE. Roberts Rugh and Erica Grupp (Columbia Univ., New York). *Am. J. Physiol.* 198, 1352-4(1960) June.

Sixty CF₁ mice were given 600 r whole-body x irradiation, a dose calculated to kill 30% in 30 days. Half were isolated as controls and the remaining half were provided with an adequate number of nonpregnant, mature females for daily matings for the next 30 days. The controls showed 33% lethality while the experimentals, aggravated by frequent sexual activity, showed 73% lethality. Sexual activity more than doubled the lethal effect of 600 r x rays. Litters derived from x-irradiated, sexually active males mated during the 1st week resulted in an average of 3.1; matings during the 2nd week produced an average of 2.7

(normal control size is 9.6). Matings during weeks 3 to 7 were sterile. Fertility was recovered by some at 8 weeks (litter size, 6.9) and by some as late as 75 days. Control x-irradiated males, after resumption of fertility, produced litters of 7.3. (auth)

18781

GENETIC EFFECTS OF X-RAYS AND CATHODE RAYS ON OOCYTES OF HABROBRACON. Gertrude Heidenthal (Russell Sage Coll., Troy, N. Y.). *Genetics* 45, 633-9(1960) May.

This paper is concerned with the problem of difference in dose rate. Are genetic effects the same, or different, when dose rates are widely different, but total dose accumulated the same? A conventional 124 kv x-ray machine was used for the low dose rate work; an electron beam generator which yielded a rate as high as 5000 r per second was the source of high dose rates. The materials irradiated were Habrobracon oocytes in first meiotic prophase and metaphase stages. These were studied for hatchability or presence of dominant and recessive lethals. F₁ virgin females were reared from prophase oocytes treated with 12,000 r. These were tested for heterozygosity with respect to recessive lethals. The data so accumulated indicate that with these materials, when total doses of x rays and cathode rays are the same, the wide difference in dose rate has no significant effect. (auth)

18782

THE TOTAL WHITE CELL COUNT OF THE BLOOD AS AN INDICATOR OF ACUTE RADIATION DAMAGE AND ITS VALUE DURING THE FIRST FEW HOURS AFTER EXPOSURE. E. V. Hulse (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). *J. Clin. Pathol.* 13, 37-41(1960) Jan.

The total white cell count of the blood is of no value in assessing the degree of acute radiation damage in rats during the first 48 hours after exposure. This is because there is a transient neutrophilia after irradiation which counteracts, to a varying extent, the reduction in numbers of the other white cells. A similar neutrophilia occurs in human patients and there is no reason to expect that the total white cell count over the same period would be of any greater value in man. It is suggested, therefore, that the total white cell count of the blood is not suitable as a method for sorting radiation casualties. (auth)

18783

BACTERICIDAL ACTION OF IONIZING RADIATIONS.

Z. G. Pershina and T. D. Yesakova (Gamalela Inst. of Epidemiology and Microbiology, Academy of Medical Sciences, USSR). *J. Microbiol., Epidemiol. Immunobiol.* (U.S.S.R.) (English Translation) 30, 72-6(1959).

The bacterial action of ionizing radiations was found to be dependent on the concentration of organisms per ml of irradiated medium. To achieve complete sterilization of concentrated suspensions (4 to 5×10^{10} organisms per ml) of the vegetative forms of bacteria, radiation doses of as high as 400,000 to 600,000 were required, and for spore-bearing forms 1,500,000 r. Of the bacteria tested the most resistant to x irradiation were *Sarcina* and *B. subtilis*. A suspension of these organisms with a density of 4×10^{10} bacteria per ml was killed by irradiation with a dose of 1,500,000 r. *E. coli* was the most sensitive. A concentrated suspension (4×10^{10} organisms per ml) was sterilized by irradiation with a dose of 400,000 r. In these conditions staphylococci occupied an intermediate position. Sterilization was achieved with a dose of 800,000 r. (auth)

18784

DIETARY FATS AND EFFECTS OF INTERNAL RADIA-

TION BY P^{32} . Camillo Artom and Hugh B. Lofland, Jr. (Wake Forest Coll., Winston Salem, N. C.). Proc. Soc. Exptl. Biol. Med. **104**, 396-9(1960) July.

Mice were maintained on various experimental diets and injected with single dose of radioactive phosphate (4 to 5 μ c/g). Higher % of survivors and longer survival time were observed in animals on fat-free diet as compared with those fed diets containing 30% corn oil, or 30% hydrogenated coconut oil. However, with these high-fat diets, as well as with diets containing only minimal amounts of fats, a better survival was demonstrable when highly unsaturated fatty acids were present. It appears that, if definite amounts of these fatty acids are included, a low-fat diet should be beneficial in alleviating effects of internal radiation by P^{32} . (auth)

18785

ERYTHROPOIETIC RECOVERY MEASURED BY Fe^{59} UPTAKE IN IRRADIATED MICE PROTECTED WITH BONE MARROW. E. A. Mirand, J. G. Hoffman, and T. C. Prentice (Roswell Park Memorial Inst., Buffalo and Univ. of Buffalo). Proc. Soc. Exptl. Biol. Med. **104**, 456-61(1960) July.

Twenty-four hour uptake of Fe^{59} was used as quick measure of erythropoiesis in Swiss male mice. In normal nonirradiated mice, iron uptake is not affected by intravenous injection of isologous, homologous, and heterologous bone marrow cells except for inocula greater than 40×10^6 cells. Injection of these cell types after 900 r whole-body x radiation increases Fe^{59} uptake rates in the order: heterologous, homologous, isologous. Protection against lethal radiation effect as measured by survival and Fe^{59} uptake depended on genetic relationship between bone marrow, donor, and recipient. (auth)

18786

EFFECT OF PRE-IMMUNIZED RAT BONE MARROW ON LETHALLY IRRADIATED MICE. Paul H. Chin and Myron S. Silverman (U. S. Naval Radiological Defense Lab., San Francisco). Proc. Soc. Exptl. Biol. Med. **104**, 506-9 (1960) July.

A comparison was made of time and incidence of death between lethally irradiated mice injected with non-immune rat bone marrow and those injected with marrow from rats pre-immunized against recipient strain of mice. Statistical analysis of data showed no significant differences between the 2 groups of animals. Similarly, a lack of significant difference was observed with marrow-treated mice given a supplementary injection of moderate amounts of either non-immune or pre-immunized rat spleen cells. The failure of sufficient numbers of immunologically active cells to colonize and proliferate is discussed as the most probable interpretation of the results. (auth)

18787

STUDIES ON THE RADIATION SENSITIVITY OF THE *E. COLI* B-STRAIN MUTANTS. Susumu Itagaki (Tokushima Univ., Japan). Tokushima J. Exptl. Med. **6**, 299-308(1960) Feb. (In English)

Radiation sensitivity of Nitromin (Nitrogen mustard oxide) resistant mutant of *E. coli* B-strain was studied, and the radiation sensitivity of x-ray resistant strain (B/r) in the diluted suspension was also examined. Nitromin fast *E. coli* B-strain (B/N-strain) showed more radiation sensitivity compared with original *E. coli* B-strain. B/N-strain has shorter lag phase and longer generation time. The increase on radiation sensitivity of B/N-strain may be attributed to the decrease of ability of recovery from the irradiation injury. The dilution effect of bactericidal effect of radiation on *E. coli* B/r-strain suspension of saline solution was determined. (auth)

18788

EFFECTS OF X-RAY IRRADIATION ON TRYPTOPHAN METABOLISM. K. Ogasawara and J. Nakamura (Wakayama Medical Coll., Japan). Wakayama Med. Repts. **5**, 9-20(1960) Jan. (In English)

Results of a series of studies on the biochemical effects of irradiation in rabbits indicate that radiation exposure induces abnormalities in tryptophan metabolism. It was concluded that the formation of oxides causes obstruction to the hepatic enzyme system involved in tryptophan metabolism. (C.H.)

Radiation Sickness

18789

SUMMARY OF PROCEEDINGS OF THE BONE MARROW TRANSPLANTATION AND CHEMICAL RADIATION PROTECTION CONFERENCE. Blood **14**, 602-4(1959) May.

Topics discussed include the procurement and preservation of bone marrow and hematopoietic tissues and the pathological effects of injected foreign bone marrow. The treatment of leukemia in mice with bone marrow therapy techniques was reviewed. Human experiments on bone marrow transplantation were discussed. The current status of chemical protection against radiation injury was discussed. A protective effect of AET against intestinal damage in mice was reported. (C.H.)

18790

SUMMARY OF PROCEEDINGS OF THE BONE MARROW TRANSPLANTATION AND CHEMICAL RADIATION PROTECTION CONFERENCE. Blood **14**, 1250-3(1959) Nov.

Topics discussed include the toxicity and pharmacology of AET in human beings and the use of AET before x irradiation or nitrogen mustard therapy; chemical protection and radiation mutation induction in bacteria and yeast; radiation accidents and treatments used on the accident victims; bone marrow procurement and transplantation in animals and man; and the transplantation of fetal blood-forming cells. (C.H.)

18791

BONE MARROW TRANSPLANTATION CONFERENCE. Blood **14**, 1254-6(1959) Nov.

Topics discussed include bone marrow transplantation in man in the treatment of radiation injuries and leukemia and the procurement and preservation of bone marrow. (C.H.)

18792

INVESTIGATION OF SOME ASPECTS OF THE ACTION OF ANTIBIOTICS IN RADIATION SICKNESS. N. N. Klemparskaia, V. F. Sosova, O. G. Alekseeva, R. V. Petrov, G. A. Chekatilo, and O. R. Nemirovich-Danchenko. J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation) **30**, 28-37(1959).

Administration of antibiotics before infection of animals irradiated with lethal doses of x rays can prevent the development of inflammatory infectious processes. It is essential to check the sensitivity of organisms in irradiated animals to antibiotics, since the resistant strains displayed enhanced virulence and their number in the tissues and skin increased. Increased antibiotic resistance was established in the intestinal autoflora of irradiated animals without the use of these antibiotics, but solely under the influence of altered conditions of their existence. Administration of antibiotics may cause neutropenia and so lower the effectiveness of the phagocytic reaction in irradiated animals. Antibiotics can suppress the development of anaphylaxis to foreign protein. Antibiotics can act as al-

lergens, apparently as the result of combination with body tissues. (auth)

18793

POLYVALENT IMMUNOLOGICAL TOLERANCE IN HOMOLOGOUS RADIATION CHIMAEAS. Alena Len-gerová (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). *Nature* 187, 160-1 (1960) July 9.

Immune reactions in the secondary disease of homologous radiation chimeras treated with embryonic hematopoietic cells are discussed. (C.H.)

18794

CONFERENCE ON CLINICAL ASPECTS OF RADIATION INJURY AND TRANSPLANTATION OF BONE MARROW AND OTHER ORGANS. SUMMARY AND DISCUSSION. C. G. Zubrod (National Cancer Inst., Bethesda, Md.). p.12-20 of "Fundamental and Clinical Aspects of Radiation Protection and Recovery, With Special Emphasis on Chemical Protection and Bone Marrow Transplantation in Mammals, No. 2, 1958-1959." Oak Ridge, Tenn., Oak Ridge National Laboratory, 1960. 20p.

Topics discussed include chemical protection against radiation injury, organ transplantation in the therapy of radiation injury, and providing a germ-free environment for patients with bone marrow damage. (C.H.)

CHEMISTRY

General and Miscellaneous

18795 AFOSR-TR-59-168

Temple Univ., Philadelphia. Research Inst. STUDY OF ULTRA HIGH TEMPERATURES. Final Report [for] May 1, 1955 to April 30, 1959. A. V. Grosse—C. S. Stokes, comp. Apr. 30, 1959. 31p. Project 7-7968. Contract AF18(600)-1475. (AD-231063)

Results of investigations on high-temperature flames are presented. Systems investigated include those involving fluorine, ozone, carbon-nitrogen-oxygen, beryllium-oxygen, zirconium-oxygen, and aluminum-oxygen. The density of metal fluorides at 1600 to 2500°K was also studied along with a method for preparation of carbon-phosphorus compounds. (J.R.D.)

18796 ANL-5668

Argonne National Lab., Ill. CHEMICAL ENGINEERING DIVISION SUMMARY REPORT [FOR] OCTOBER, NOVEMBER, AND DECEMBER 1956. Mar. 1957. Decl. Mar. 21, 1960. 111p. Contract W-31-109-eng-38. OTS.

A study of mass transfer in a continuous-flow mixing chamber, fluoride volatilization separations process, corrosion testing in fused fluoride systems, behavior of Pu during volatilization of UF_6 , preparation of PuF_6 by fluorination of PuF_4 , particle size distribution and U content of UF_4 , stoichiometric behavior of the reaction $IF_5 + F_2 + I_2$, ignition data on stainless steel, were reported. Studies were continued on the analysis of crude green salt from U ore concentrates, fluidized-bed green salt pilot plant, calcination of reactor fuel wastes, reactor chemistry, chemical-metallurgical separation processes, waste processing operations, and the operation of the gamma-irradiation facility. (W.L.H.)

18797 CF-58-9-72

Oak Ridge National Lab., Tenn. SUMMER QUARTER, 1958, CO-OP REPORT. M. O. Smith. Sept. 25, 1958. 16p. OTS. Short-term work on the Fluorox fluidized bed oxidation

process and fluidized bed reactor is reported. Work done on cleanup of mercury from the Metallex process is also described. (J.R.D.)

18798 EXP-NRX-2805

Atomic Energy of Canada Ltd., Chalk River, Ont. CHEMISTRY OF THE FIRST UO_2 FUEL FAILURE IN THE X-2-s TEST. G. M. Allison, I. H. Crocker, and R. C. Hawkings. July 1959. 43p. (AECL-1012). AECL.

During a UO_2 fuel test in the X-2 loop in the NRX reactor a defect occurred in one of the fuel specimens. The test was continued for an additional 14 days before high activity in the loop water brought it to an end. From monitor behavior and radiochemical data it was postulated that the defect in the sheath began as a very small hole which gradually enlarged due to corrosion until it reached 0.25 inches diameter. Escape-rate coefficients calculated for Kr^{88} , Cs^{138} and three iodine isotopes for the period when the defect hole was small indicated the release of activity to be similar to that observed in the X-2-q defect test. This was not unexpected since the defected specimens were similar in heat rating and density. Examination of the gamma activity in loop water samples with a scintillation crystal and pulse-height analyzer showed that the major activities present after at least 46 minutes were the fission-product gases, their daughters and the iodines. It was not possible to determine the amount of UO_2 lost from the failed element but a minimum figure of 6.6 mg was estimated as added to the loop test section by the fuel failure. (auth)

18799 GEAP-3338

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.

METAL-WATER REACTIONS: IX. THE KINETICS OF METAL-WATER REACTIONS—FEASIBILITY STUDY OF SOME NEW TECHNIQUES. Sydney C. Furman and Paul A. McManus. Jan. 31, 1960. 53p. Contract AT(04-3)-189, Project Agreement No. 1. OTS.

A feasibility study was carried out which demonstrated the ability of the Thermotot, a commercial radiometer, to follow temperature transients occurring as the result of the zirconium-steam reaction. The instrument was employed to measure surface temperature at 1600 to 2300°C; the instrument is capable of covering a much wider range of temperature. In the study of the Thermotot, electromagnetic levitation melting of zirconium was developed. Zirconium was melted while suspended in a radio-frequency field. The design of coils required to obtain symmetric and relatively quiescent melts is discussed. Emissivities of oxidized and non-oxidized zirconium surfaces were measured at 0.65 μ , with an optical pyrometer and at 2.3 μ with the Thermotot modified with a special filter. The considerations important in the interpretation of temperature measurements in regard to reaction rates are discussed. Suggestions for additional studies are made. (auth)

18800 NP-8843

Koppers Co., Inc., Pittsburgh. QUARTERLY PROGRESS REPORT [ON DIELECTRIC MATERIALS]. Philip E. Brumfield, Alexander Lebovits, Bernard Rudner, Samuel C. Temin, and E. E. Donath. June 1960. 22p. Project 7371. Contract AF33(616)-7021.

Research and development on preparation of thiazoles and fluoroolefin polymers suitable for high-temperature dielectric materials applications are reported. Emphasis during the report period was placed on the synthesis and study of model derivatives of thiazole having various combinations of aromatic groups attached at ring positions 2, 4, and 5. Center cut distillation samples are being col-

lected and characterized for each compound. In research on fluoroolefin polymers the effort was directed toward synthesis of monomers of the type $\text{RCF} = \text{CF}_2$ where R is a stable ring other than benzene or triazine. Several experiments involving organic lithium compounds and tetrafluoroethylene are described. It appears that the reaction between 2-pyridyllithium and tetrafluoroethylene will produce a desirable monosubstituted olefin. (J.R.D.)

18801 NP-8859

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE SYNTHESIS OF DIBENZYL TELLURIDE. Report No. 149/XIII. R. Sochacka and A. Szuchnik. May 1960. 6p.

A rapid method of preparing dibenzyl telluride from tellurium was developed in which sodium telluride is formed, followed by benzylolation with benzyl chloride. The synthesis takes about 30 minutes and gives a yield of 90%. (auth)

18802 NRL-5457

Naval Research Lab., Washington, D. C.

THE STABILIZATION OF SILICONE LUBRICATING LIQUIDS ABOVE 200°C. PART I. CONVENTIONAL OXIDATION INHIBITORS AND SOME HIGH-SURFACE SOLIDS. H. R. Baker, F. F. Sullivan, and C. R. Singleterry. Jan. 15, 1960. 33p.

A study of the stabilization of silicone oils at temperatures between 250 and 371°C showed that the useful life of the commercially available types may be extended from three to five times by the use of certain oxidation inhibitors known to be effective in other systems. The relative value of different inhibitors varies with the temperature and the aromatic content of the oil. The deterioration of silicones in this temperature range is primarily an oxidative process. This oxidation is inhibited by high-surface solids such as Shawanigan black, copper phthalocyanine, and ferric oxide, by conventional inhibitors of the arylamine type, and by dilauryl selenide. Dilauryl selenide was ineffective at 300°C and higher; phenylalphanaphthylamine caused a relatively uniform improvement at 250 and 300°C. The gains from any inhibitor were small at 371°C. The chemical diversity of the effective inhibitors and the relatively high temperatures at which they are effective suggest that the mechanism of inhibition differs from that operating in conventional oils at temperatures below 200°C. The improvements shown with lightly phenylated silicones permit formulation of lubricants having acceptable viscosity characteristics and oxidation stability over the range from -55°C or lower to 305°C. New types of inhibitors, specifically for use with silicone liquids, which are an order of magnitude more effective than conventional inhibitors were discovered. (auth)

18803 NRL-5471

Naval Research Lab., Washington, D. C.

WETTING PROPERTIES OF TETRAFLUOROETHYLENE AND HEXAFLUOROPROPYLENE COPOLYMERS. Marianne K. Bennett and W. A. Zisman. Feb. 16, 1960. 8p.

Of all solid organic polymers polytetrafluoroethylene is known to have the lowest surface energy and thus the lowest critical surface tension of wetting (γ_c). In this study the wettability of a series of copolymers of tetrafluoroethylene with hexafluoropropylene by a variety of organic and inorganic liquids was examined. The results show that these solid plastics have critical surface tensions which are even lower than that of solid polytetrafluoroethylene. As anticipated, the progressive increase in the proportion of perfluoromethyl side chains in the polymer introduces a higher concentration of exposed $-\text{CF}_3$ groups in the sur-

face, which in turn progressively reduces γ_c . By extrapolation γ_c of a polyhexafluoropropylene was calculated to give the value 15 dynes/cm. (auth)

18804 SCS-R-134

Gt. Brit. Springfields Works, Springfields, Lancs, England. A SURVEY OF THE ABSORPTIVE BEHAVIOUR OF FOURTEEN METALLIC DITHIZONATES ON ACTIVATED ALUMINA. A. P. Seyfang and J. E. Dunabin. Apr. 14, 1950. 8p.

Spectrographic and chromatographic techniques revealed that metals which form stable dithizonates in carbon tetrachloride may readily be absorbed on activated alumina. (C.J.G.)

18805 TID-6096

Georgian Court Coll., Lakewood, N. J.

ABSORPTION SPECTRA AND CONDUCTIVITY MEASUREMENTS OF SOME METAL CHELATES. Period covered: September 15, 1959 to and including June 15, 1960. Mary Peter Coakley. June 15, 1960. 35p. Contract AT(30-1)-2069. OTS.

Ultraviolet measurements in potassium bromide disks of the 2:1 complexes of 8-aminoquinoline with the chlorides of copper and magnesium and the 1:1 complexes with the chlorides of zinc, cadmium, nickel and palladium(II) show a shift toward shorter wavelengths from that of the 8-aminoquinoline in the 300mμ region. The extent of the shift is almost identical for the magnesium, zinc, cadmium, nickel, and copper chelates indicating that the metals are equally effective in blocking the resonance between the amino group and the quinoline ring by the nitrogen-to-metal bond formation. These results are in contrast to previous investigations of coordination by aryl amines, in which the hypsochromic shifts were related to the relative nitrogen-to-metal bond strengths. The ultraviolet spectra of the 8-aminoquinoline complexes in dioxane do reveal differences in the values of the wavelength maxima. The spectrum of the magnesium complex indicates that this solvent completely replaces the amino group in the coordination sphere of the metal. Conductivity data in nitrobenzene indicate appreciable dissociation of chloride ion from the copper, nickel, and magnesium complexes. Absorption patterns in the three micron region reveal the expected decreases in the frequencies of the N-H stretching vibration on chelation. The spectrum of the copper chelate in this region is more complex than the usual pattern observed for trans complexes. Completion of the study of the o-phenylenediamine complexes in the solid state revealed a shift to shorter wavelengths in the ultraviolet region of the spectrum with the exception of the magnesium complex. The extent of the shift is as follows: $\text{Pd} > \text{Zn} > \text{Ni} > \text{Cd} > \text{Mg}$. The hypsochromic shifts are related to the relative nitrogen-to-metal bond strengths. (auth)

18806 TID-6163

Minnesota. Univ., Minneapolis.

PROGRESS REPORT [ON REMOVAL OF STRONTIUM-85 FROM MILK] COVERING PERIOD: NOVEMBER 1, 1959 TO JUNE 1, 1960. W. D. Armstrong and Leon Singer. 28p. Contract AT(11-1)838. OTS.

Hazards due to the accumulation of radiostrontium in the food chain and the desirability of developing standby methods for use in the removal or reduction of radiostrontium in milk are discussed. Various techniques are described in which pulverized bone or other apatite substances are used as cation exchange material for reducing the concentration of radiostrontium in milk. In these studies the milk was passed through a column of pulverized bone or other apatite substance and the effectiveness

of these materials in reducing the strontium-85 concentration of the milk was determined. The most effective apatites used in the column treatment were anorganic bone prepared by removal of the protein, fat-free bone, potassium hydroxide-ethylene glycol ashed bone, and steamed bone from commercial sources. Data are tabulated. (C.H.)

18807 TID-6175

Westinghouse Electric Corp. Research Labs., Pittsburgh. THE EFFECT OF PRESSURE ON MICROGRAVIMETRIC STUDIES IN HYDROGEN. Scientific Paper 11-0807-11-P1. O. M. Katz and E. A. Gulbransen. Jan. 1960. 19p. Contract AT-11-1-GEN-14. OTS.

The calculation of specimen weight change from balance deflection in the pressure range 10^{-3} to 20 mm of Hg of H_2 must be corrected by an amount that depends on the pressure and temperature of reaction. This correction may be minimized by heating the counterweight, introducing radiation shields, adjusting the thermal gradient in the furnace, and altering the temperature differential between specimen and counterweight. Any residual correction can be ascertained from reproducible calibration curves that are applicable for a given piece of apparatus and specimen surface area. True buoyancy due to a difference in density between specimen and counterweight is not a factor. Thermal molecular flow patterns in the furnace tubes probably cause the pressure effect. (auth)

18808 WADC-TR-58-187(Pt. III)

Wyandotte Chemicals Corp., Wyandotte, Mich. and Illinois. Univ., Urbana.

SYNTHESIS AND EVALUATION OF HIGH TEMPERATURE STABLE AND NUCLEAR RADIATION STABLE METAL-CYCLOPENTADIENYL FLUIDS. Period covered: March 1959 to March 1960. Robert L. Schaaf, Peter T. Kan, and Kenneth L. Rinehart, Jr. Apr. 15, 1960. 96p. Projects 3044 and 7312. Contract AF33(616)-5053.

In a search for liquids suitable for use as high-temperature hydraulic fluids and lubricants, six new siloxanyferrocenes were synthesized, and the thermal stability, viscosity and fluid range were determined. Efforts to find feasible routes to 1,1'-bis (aryloxyphenyl)-ferrocenes, polychloroferrocenes, and polymeric perfluoroalkylbenzimidazoles were unsuccessful. From the lithiation and subsequent carbonation of dimethylferrocene, the enantiomeric forms of 1,1'-dimethylferrocene-3-carboxylic acid were isolated, and 1,1'-dimethylferrocene-2-carboxylic acid and a mixture of di-acids were obtained. By reduction of the required esters with lithium aluminum hydride, mono- and bis-hydroxymethylferrocenes were prepared. Oxidation of desoxyferrocene, methyl-, and ethyl-ferrocene with manganese dioxide gave ferrocil, formyl-, and acetyl-ferrocene, respectively. The reduction of nitroferrocene, prepared from *n*-propyl nitrate and lithioferrocene, was investigated. Attempts to prepare nitrosoferrocene, 1,1'-diaminoferrrocene, and to unite hydroxymethylferrocene with methyl linolenate or ethyl linoleate were unsuccessful. (auth)

18809 WADC-TR-59-95(Pt. II)

Monsanto Chemical Co., [Everett, Mass.]. SYNTHESIS OF 1000°F STABLE BASE FLUIDS. [Period covered]: February 2, 1959 to January 31, 1960. James W. Dale, Iral B. Johns, Elizabeth A. McElhill, and John O. Smith. Jan. 31, 1960. 60p. Project No. 1428. Contract AF33(616)-5553.

A total of 50 compounds was tested in the vapor liquid, or condensed phase for stability at 1000°F. Many of the compounds were synthesized. Several perfluorocyclic compounds were prepared by fluorination of the corresponding

aromatics, and in the case of $(CNF)_3$, by fluorination of $(CNCl)_3$ with SbF_3Cl_2 . Other fluoroorganics, phenyl- or pyridyl-substituted perfluoroalkanes, were synthesized from SF_4 and the corresponding ketones or carboxylic acids. Evidence was obtained of a new reaction of SF_4 with aryl oxalates and other oxalic acid derivatives. Compounds found stable over 1000°F included dibenzothiophene and tetrakis (perfluoromethyl) pyrazine and perfluorocyclobutane-perfluoroisobutylene. (For preceding period see WADC-TR-59-95.) (C.J.G.)

18810 AEC-tr-4119

THE STRUCTURE OF CERTAIN LIQUIDS. I. ON THE RESULTS OF STUDIES OF THE STRUCTURE OF MONATOMIC LIQUIDS. O. Ya Samoilov (Samoylov). Translated by S. J. Rothman from *Zhur. Fiz. Khim.* 30, 241(1956). 12p. JCL or LC.

The dependence of the structure of liquids on the thermal motions of the particles which constitute the liquid was studied. The only quantitative method of describing the structures of monatomic liquids was the construction of radial distribution curves calculated from experimentally measured scattered x-ray intensities. Distribution curves for the liquid states of lead, xenon, lithium, sodium, and potassium were plotted for study. The existence of maxima in these curves indicated the presence of preferred interatomic distances and corresponded to a series of equilibrium coordination spheres in the liquid. The first maximum of the radial distribution curve was found to determine the region of "neighboring coordination" and was connected with the vibration motion of the atom. The average number of atoms found at distances not exceeding the limits of this region was called the coordination number of the atom in the liquid. The relations of coordination number to thermal expansion, temperature changes, melting, and specific resistivity were studied. The chief importance of the coordination number for characterizing monatomic liquids was its dependence on the relative location of the temporary equilibrium in the liquid (the initial lattice) as well as the translational motion of the atoms. (M.C.G.)

18811 AEC-tr-4122

REACTIONS INVOLVING SOLIDS IN THE ABSENCE OF ANY CATALYTIC ACTION OF THE REACTION PRODUCTS. M. M. Pavlyuchenko. Translated by Lydia Venters (Argonne National Lab.) from *Zhur. Fiz. Khim.* 23, 800-8 (1949). 14p. JCL or LC.

Two cases of the kinetics of chemical reactions involving solids are discussed, and kinetic equations are derived for them. It is shown that regardless of the aggregate state of the reaction products and their catalytic effect, the curves of dependence of reaction rate on time pass through maxima. On the basis of the concepts discussed one may assume that the S-shape of the curve may be explained by the noncatalytic effect of the reaction product. (W.L.H.)

18812 AEC-tr-4123

THE FUNDAMENTAL EQUATION OF TOPOCHEMICAL REACTIONS WHICH ARE NOT CATALYZED BY THE SOLID REACTION PRODUCT. M. M. Pavlyuchenko. Translated by Lydia Venters (Argonne National Lab.) from *Zhur. Fiz. Khim.* 23, 800(1949). 6p. JCL or LC.

On the basis of a concept on a nonequivalent linear reaction rate in two mutually perpendicular planes, the equation of dependence of the reaction rate on time is derived for the case when the reaction begins at individual surface points. (W.L.H.)

18813 JPRS-2736

THE ISOTOPE EXCHANGE METHOD FOR MEASURING SATURATED VAPOR PRESSURE AND DIFFUSION COEF-

FICIENTS. I. THE EFFECT OF THE MOLECULAR CONDENSATION COEFFICIENTS ON THE RATE OF THE EXCHANGE REACTION. V. I. Lozgachev. Translated from *Zhur. Fiz. Khim.* 33, 2755-66(1959). 20p. OTS.

Equations are presented for the probabilities of transfer of the molecules from one specimen to another in a closed vessel or in a vacuum as a function of the geometry of the system and of the condensation coefficients. The rate of isotope exchange through the gaseous phase is dependent on the condensation coefficient. (W.L.H.)

18814 JPRS-2763

A STUDY OF THE ISOTOPE EXCHANGE BETWEEN GASEOUS OXYGEN AND THE SALTS OF SOME ACIDS CONTAINING OXYGEN AT HIGH TEMPERATURES. V. I. Spitsyn and V. G. Finikov. Translated from *Problemy Kinetiki i Kataliza*, Akad. Nauk S.S.S.R., Inst. Fiz. Khim., Soveshchanie, Moscow, 1956, 9, 264-6 (Pub. 1957). 6p. OTS.

The study of the velocity of the isotope exchange between the gaseous oxygen and the solid salts of an oxygen-containing acid presents considerable interest inasmuch as it permits evaluation of the bond energy in the compounds. Isotope exchange between gaseous oxygen and sulfates of alkali elements and also between sodium molybdate and carbonate was studied with the purpose of comparing the stability of the oxygen bond in these salts. To conduct these experiments, oxygen was used containing about 1.3% of the O^{18} atom. The measurement of the O^{18} and O^{16} isotope content was conducted by the mass spectrometer method. (auth)

18815 RAE-Lib-Trans-839

THE GRAPHITIZATION OF CARBON. PART I. PARTICLE SIZE, CRYSTAL STRUCTURE AND SPECIFIC GRAVITY. (Ueber die Graphitierung von Kohlenstoff. Teil 1. Korngrösse, Kristallstruktur und Spezifisches Gewicht). O. Hauser. Translated by H. C. Ranson from *Z. physik. Chem. (Leipzig)* 209, 335-51(1958). 14p. (AD-228347).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 155.

18816

THERMODYNAMIC STUDY OF ASSOCIATED SOLUTIONS. I. ISOTOPIC EFFECT ON DEMIXING. Robert Cardinaud (Ecole Centrale des Arts et Manufactures, Paris). *Bull. soc. chim. France* No. 4, 622-6(1960) Apr. (In French)

The experimental study of the demixing of the associated systems of heavy water-deuterated phenol and deuterated methanol-cyclohexane shows an isotopic effect. The comparison of the results obtained seems to indicate that if the deuteration re-enforces the association, the re-enforcement of the energy effect is more important between molecules of the same nature than between molecules of different nature in the particular case of the heavy water-deuterated phenol system. (tr-auth)

18817

THERMODYNAMIC STUDY OF ASSOCIATED SOLUTIONS. II. EXPERIMENTAL STUDY OF THE ISOTOPIC EFFECT ON THE VAPOR PRESSURES. Robert Cardinaud (Ecole Centrale des Arts et Manufactures, Paris). *Bull. soc. chim. France* No. 4, 626-8(1960) Apr. (In French)

The experimental methods currently utilized were adapted to the problem to trace the isotherms of constant isotopic composition. The systematic variation observed between isotherms of different isotopic composition shows a difference of behavior of the two isotopic varieties of phenol in solution in carbon tetrachloride. (tr-auth)

18818

ASSOCIATION OF SOLUTIONS OF DEUTEROMETHANOL AND DEUTEROPHENOL. III. INFRARED SPECTRO-

SCOPIC STUDY. Robert Cardinaud (Ecole Centrale des Arts et Manufactures, Paris). *Bull. soc. chim. France* No. 4, 629-34(1960) Apr. (In French)

The experimental data obtained in this case show that the association band ν_{OH} is systematically larger than the ν_{OD} association band both for methanol and phenol. With the aid of a correction for deuteration, it can be shown that the deuterio-phenol is more associated than ordinary phenol and it is probably the same for deuterio-methanol whose coefficient of molar extinction is less than that of methanol. (tr-auth)

18819

ISOTOPE EFFECT IN THE HYDROGEN ATOM-FORMALDEHYDE REACTION. James R. McNesby, Milton D. Scheer, and Ralph Klein (National Bureau of Standards, Washington, D. C.). *J. Chem. Phys.* 32, 1814-17(1960) June.

The isotope effect in the hydrogen abstraction from formaldehyde by hydrogen atoms was measured. The activation energy difference derived from relative rate measurements of the pair of reactions, $H + H_2CO \rightarrow H_2 + HCO$ and $H + D_2CO \rightarrow HD + DCO$, is $E_5 - E_2 = 1.0$ kcal. The value for the corresponding pair, $D + H_2CO \rightarrow HD + HCO$ and $D + D_2CO \rightarrow D_2 + DCO$, $E_7 - E_8 = 0.9$ kcal, is calculated from the variation of the hydrogen-deuterium equilibrium constant with temperature. Application of the Bigeleisen theory of the isotope effect to these reactions suggests a loosely bound activated complex. (auth)

18820

QUADRUPOLE RESONANCE SPECTRUM OF CHLORANIL AND ITS HEXAMETHYLBENZENE COMPLEX. Dean C. Douglass (Cornell Univ., Ithaca, N. Y.). *J. Chem. Phys.* 32, 1882-3(1960) June.

The nuclear quadrupole resonance spectrum of Cl in chloranil and in the 1:1 complex of chloranil with hexamethylbenzene was obtained at 77°K and room temperature. The results are used to estimate the upper limit for charge transfer in the complex from chloranil to hexamethylbenzene. Complexes of picrylchloride: hexamethylbenzene and parachloroaniline: sym-trinitrobenzene were also studied but no resonances were detected. (D.L.C.)

18821

NOTE ON SECONDARY ISOTOPE EFFECTS IN REACTION RATES. Max Wolfsberg (Oxford Univ.). *J. Chem. Phys.* 33, 2-6(1960) July.

Secondary kinetic isotope effects, for all isotopes with the possible exception of hydrogen isotopes, were shown to be small unless the force constants involving the isotopically substituted positions were considerably different in the transition state from those in the reactant. Cases involving secondary hydrogen isotope effects were investigated in detail for certain model reactions. It was concluded that hydrogen isotope effects do not constitute an exception to the above rule. (auth)

18822

STRUCTURE OF THE COMPLEX ION IN AQUEOUS SOLUTIONS OF ZIRCONYL AND HAFNYL OXYHALIDES. George M. Muha and Philip A. Vaughan (Rutgers Univ., New Brunswick, N. J.). *J. Chem. Phys.* 33, 194-9(1960) July.

X-ray scattering by aqueous solutions of $MOX_2 \cdot 8H_2O$ ($M = Zr$ and Hf , $X = Cl$ and Br) can be explained if one assumes the existence of a complex $[M_4(OH)_8(H_2O)_{16}]X_8$. The metal atoms in this complex are arranged in a square and are held together by double OH bridges along each edge. In addition, each metal atom is bound to four additional water molecules in such a manner that the con-

figuration about the metal is a square Archimedes anti-prism. The halogen ions are not bound directly to the metal. They do, however occupy definite positions in the complex, and are presumably held in place by electrostatic forces. The structure is very similar to that which has been found in the crystalline oxyhalides. (auth)

18823

THE KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. PART X. THE ACID-CATALYSED DETRITIATION OF $[o\text{-}^3\text{H}]p\text{-CRESOL}$ IN WATER AND IN DEUTERIUM OXIDE. V. Gold, R. W. Lambert, and D. P. N. Satchell (King's Coll., London). *J. Chem. Soc.* 2461-6(1960) June.

The loss of tritium from $[o\text{-H}^3]p\text{-cresol}$ was studied kinetically in aqueous hydrochloric acid in the approximate concentration range 3.5 to 6.5N. The reaction velocity was found to have the same dependence on acidity as the previously investigated exchange of $[o\text{-H}^3]p\text{-cresol}$. At the same acidity, detritiation is 2 to 3 times slower than deuteration. The detritiation occurs 1.62 times faster in deuterium oxide than in protium oxide solutions of 4N hydrochloric acid. The velocity in mixtures of deuterium oxide and water follows the predictions of the Gross-Butler theory. The mechanism of aromatic hydrogen exchange is discussed. (auth)

18824

OXIDATIONS OF ORGANIC COMPOUNDS WITH QUINQUEVALENT VANADIUM. V. A. COMPARATIVE STUDY OF THE OXIDATION OF ALCOHOLS AND GLYCOLS BY CERIUM(IV), VANADIUM(V), AND CHROMIUM(VI). J. S. Littler and William A. Waters (Dyson Perrins Lab., Oxford). *J. Chem. Soc.* 2767-72(1960) June.

The rates of oxidation of a number of alcohols and glycols were measured in both water and deuterium oxide using as oxidants vanadium(V), cerium(IV), and chromium(VI) in sulfuric acid. Differences between the mechanisms of oxidation by these reagents are discussed. (auth)

18825

RESPONSE OF THE β -RAY IONIZATION DETECTOR TO UNESTERIFIED LOWER FATTY ACIDS IN GAS-LIQUID CHROMATOGRAPHY. C. J. F. Böttcher, G. F. G. Clemens, and C. M. van Gent (Univ. of Leiden). *J. Chromatog.* 3, 582-4(1960) June.

The response of the β -ray ionization detector was studied in the gas-liquid chromatography of the lower fatty acids with a polyester of maleic acid, adipic acid, and ethylene glycol as the stationary phase. The values for the peak area per unit mass relative to that for pelargonic acid were found to increase with the molecular weight up to 150, in contradiction to Lovelock's equation which predicted a decrease. The difference is attributed to the carboxyl group. The data were found to fit the equation $A_r = 2.5 \log n - 1.41$, A_r being the relative area per mole and unity for pelargonic acid, and n = the number of carbon atoms in the molecule. (D.L.C.)

18826

A NEW COMPLEX URANIUM COMPOUND, $5\text{UCl}_5 \cdot \text{CCl}_2 = \text{COCl}$ — COCl (PENTA-URANIUM PENTACHLORIDE, TRICHLOROACRYLYL CHLORIDE). R. E. Panzer (U. S. Naval Ordnance Lab., Corona, Calif.) and J. F. Suttle (Univ. of California, Berkeley). *J. Inorg. & Nuclear Chem.* 13, 244-7(1960) May.

A dark red co-ordination compound of uranium, $5\text{UCl}_5 \cdot \text{CCl}_2 = \text{COCl}$ — COCl is reported. The material is the primary reaction product from uranium trioxide and hexachloropropene. It is readily dechlorinated to form uranium tetrachloride, trichloroacrylyl chloride and chlorine. The material is probably triclinic. Indices of re-

fraction are greater than 1.600. The compound melts at 96°C (closed tube) without decomposition. The compound could not be separated into uranium pentachloride and the organic portion without decomposing the UCl_5 . Ionizing nonaqueous solvents dissolve it readily and it reacts with PCl_5 in phosphorus oxychloride to form $\text{UCl}_5 \cdot \text{PCl}_5$. A structure is postulated in which a molecule of UCl_5 is co-ordinated to each of the five available chlorine or oxygen atoms of trichloroacrylyl chloride. (auth)

18827

PHOTOSUBSTITUTION REACTIONS OF SOME Cr(III) COMPLEXES. A. W. Adamson (Univ. of Southern California, Los Angeles). *J. Inorg. & Nuclear Chem.* 13, 275-85(1960) May.

The ion $\text{Cr}(\text{H}_2\text{O})_6^{3+}$ is found to undergo second order photochemical substitution reactions with thiocyanate and chloride ions, and, likewise, $\text{Cr}(\text{NH}_3)_5(\text{H}_2\text{O})^{3+}$, with thiocyanate ion. Quantum yields for the forward and reverse reactions are given for wavelengths 400 to 575 m μ , and, for the first system, at several temperatures. It is suggested that the mechanism for the second order processes involves formation of an ion pair which undergoes a photochemical outer-inner sphere exchange of ligands. An evaluation is made of the evidence bearing on the exact nature of the photoactivated state involved. From a study of the reverse or photoaquation reactions, in the case of the thiocyanate containing systems, it is possible to calculate the pseudo equilibrium constants for the photostationary states obtained after long irradiation. Since these are wavelength dependent, the systems are photochromic in nature and may have some useful applications. (auth)

18828

INFRA-RED AND VISIBLE ABSORPTION STUDIES OF THE PENTACYANONICKELATE(II) ION IN AQUEOUS SOLUTION. R. L. McCullough, L. H. Jones, and R. A. Penneman (Los Alamos Scientific Lab., N. Mex.). *J. Inorg. & Nuclear Chem.* 13, 286-97(1960) May.

The infrared spectra of aqueous solutions containing tetracyanonickelate(II) and excess cyanide ions show a single new absorption peak characteristic of the pentacyanonickelate(II) ion, $[\text{Ni}(\text{CN})_5]^{3-}$. The growth of this new infrared peak and the diminution of the known $[\text{Ni}(\text{CN})_4]^{2-}$ absorption is described completely by the equilibrium: $[\text{Ni}(\text{CN})_4]^{2-} + \text{CN}^- \rightleftharpoons [\text{Ni}(\text{CN})_5]^{3-}$ over a cyanide concentration range 0.05 to 5 M. No infrared absorption of a higher complex, e.g. $[\text{Ni}(\text{CN})_6]^{4-}$ was detected even in nearly saturated NaCN and ~0.4 M $[\text{Ni}(\text{CN})_4]^{2-}$. Infrared absorption characteristics of the complex ions are: $[\text{Ni}(\text{CN})_4]^{2-}$, $\epsilon = 1068 \pm 95 \text{ mole}^{-1} \text{ l. cm}^{-1}$ at 2124 ± 1 , and $[\text{Ni}(\text{CN})_5]^{3-}$, $\epsilon = 1730 \pm 230 \text{ mole}^{-1} \text{ l. cm}^{-1}$ at 2102 ± 2 . Continuous variation experiments at 100 Å intervals from 3800 Å to 6000 Å showed only a 1:1 complex between CN^- and $[\text{Ni}(\text{CN})_4]^{2-}$. From visible and infrared absorption data the constant for the formation of $[\text{Ni}(\text{CN})_5]^{3-}$ from $[\text{Ni}(\text{CN})_4]^{2-}$ and CN^- was found to be $0.19 \pm 0.01 \text{ l. mole}^{-1}$ at 25.2° in solutions of constant ionic strength ($\mu = 1.34$). The formation constant was determined at three temperatures at 15 to 35° , yielding a ΔH of ~3 kcal/mole. Magnetic measurements show that the pentacyanonickelate(II) ion is diamagnetic. (auth)

18829

A STUDY OF TRANSFERENCE AND SOLVATION PHENOMENA. I. URANYL CHLORIDE IN WATER, ETHANOL AND WATER-ETHANOL SOLVENTS. D. M. Mathews, J. O. Wear and E. S. Amis (Univ. of Arkansas, Fayetteville). *J. Inorg. & Nuclear Chem.* 13, 298-309(1960) May.

Transference and solvation phenomena involving uranyl

chloride (UO_2Cl_2) were studied at $25.00 \pm 0.01^\circ\text{C}$ in water, ethanol, and water-ethanol solvents. Transference phenomena as a function of the concentration of UO_2Cl_2 were studied at the same temperature in water and in 99.7 wt.% ethanol in water. The transference number of the anion in both water and in 99.7 wt.% ethanol extrapolates to 0.64 and the cation to 0.36 at infinite dilution of the UO_2Cl_2 . The transference number of the anion as a function of concentration reaches a maximum of unity at about 19.5 wt.% UO_2Cl_2 and then decreases sharply with further increase of salt concentration. The maximum in water is explained as possibly arising from $[\text{UO}_2\text{Cl}_3 \cdot \text{solvent}]^-$ and $[\text{UO}_2\text{Cl} \cdot \text{solvent}]^+$ ions of equal mobility. The dependence of anion transference number on solvent composition is qualitatively in agreement with the dependence, with respect to uranium(VI) ion, of the order of the electron exchange reaction between uranium(VI) and uranium(IV) ions. The plot of the moles of water per faraday transported from anode to cathode gave a sine-like curve when plotted against weight per cent ethanol in the solvent. The shape of this curve was explained on the basis of the alternate removal of layers of water of hydration on the UO_2Cl_3^- and UO_2Cl^+ ions and the successive replacement of these hydration layers with ethanol. (auth)

10830

LIQUID SCINTILLATORS. XII. ABSORPTION AND FLUORESCENCE SPECTRA OF 2,5-DIARYL-1,3,4-OXADIAZOLES. Donald G. Ott, Vernon N. Kerr, F. Newton Hayes, and Elizabeth Hansbury (Los Alamos Scientific Lab., N. Mex.). *J. Org. Chem.* **25**, 872-3(1960) May.

Tables of absorption and fluorescence spectral data are given for a large number of 2,5-diaryl-1,3,4-oxadiazoles. The effect of an oxadiazole group on the spectrum of an aromatic system is very similar to that of a p-phenylene group. Fluorescence and absorption maxima of the oxadiazoles occur at shorter wavelengths than for the corresponding oxazoles. Synthesis of two new pyridyl derivatives is reported. (D.L.C.)

18831

ADSORPTION FROM LIQUID MIXTURES AT SOLID SURFACES. C. G. Gasser and J. J. Kipling (The University, Hull, Eng.). *J. Phys. Chem.* **64**, 710-15(1960) June.

There are at least four major factors which appear to be important in considering adsorption from the liquid phase onto solids: (a) the thickness of the adsorbed film, (b) the orientation of the adsorbed molecules, (c) the polarity of the solid surfaces, (d) the interaction between the liquid components. These factors probably are relevant in the choice of solutes designed to stabilize dispersions. Adsorption by charcoal from mixtures of benzene with each of the lower aliphatic alcohols is considered in the light of these four factors. Adsorption can be interpreted as being confined to a monolayer, the alcohol molecules being adsorbed with the major axis parallel to the solid surface. The competitive adsorption is affected both by interaction between the liquid components and by strong interaction between the alcohol molecules and oxide complexes on the adsorbing surface. (auth)

18832

A SPECTROPHOTOMETRIC STUDY OF THE COMPLEXES FORMED BETWEEN URANYL AND CHLORIDE IONS IN WATER AND WATER-ETHANOL SOLVENTS. Jack D. Hefley and Edward S. Amis (Univ. of Arkansas, Fayetteville). *J. Phys. Chem.* **64**, 870-72(1960) July.

Using the method of continuous variations at 25° , the complex ion UO_2Cl^+ was proved to exist in dilute aqueous solutions. In more concentrated aqueous solutions, 0.237

to 1.58 M in uranyl ion, the complexes UO_2Cl^+ , UO_2Cl_2 and UO_2Cl_3^- were found. With 30 and 60 volume % ethanol in the solvent, the complex ion UO_2Cl^+ exists. All these complexes were found using a tungsten lamp on the Beckman DU spectrophotometer. In 90 volume % ethanol using a hydrogen discharge lamp on the Beckman DU spectrophotometer and a wave length of 288 m μ the existence of the UO_2Cl^+ ion was proved. The equilibrium constant for the dissociation of the complex ion UO_2Cl^+ in water and in 30, 60 and 90 volume % ethanol was found to be 2.28×10^{-2} , 1.65×10^{-1} , 5.10×10^{-1} and 1.47×10^{-3} , respectively. (auth)

18833

NUCLEAR MAGNETIC RESONANCE STUDIES OF HYDROGEN BONDING. I. CARBOXYLIC ACIDS. Jeff C. Davis, Jr. and Kenneth S. Pitzer (Univ. of California, Berkeley). *J. Phys. Chem.* **64**, 886-92(1960) July.

The proton magnetic resonance spectra of solutions of formic, acetic, and benzoic acids in benzene were studied in the temperature range 20 to 100° . Previously reported equilibrium constants and heats of dimerization are employed to calculate the chemical shifts of the monomer and dimer species of the acids. Exceptionally high shieldings are found for the monomers at room temperature which shift to lower applied fields at higher temperatures. Association of the acid monomers with the aromatic solvent is a possible explanation of these results. The nature of the higher acid polymers is also discussed. (auth)

18834

ISOTOPE EFFECT IN PYROLYSIS OF $\text{C}^{14}\text{H}_3\text{COONa}$. Ignacy Złotowski and Mieczysław Zieliński (Univ. of Warsaw). *Nukleonika* **5**, 27-32(1960). (In Polish)

The isotope effect of C^{14} in the pyrolysis of $\text{C}^{14}\text{H}_3\text{COONa}$ at 450°C was investigated. Results of measurements give the average value: $3.4 \pm 0.4\%$. The experimental results were compared with theoretical isotope effects evaluated by using the "three center model" suggested by Bigeleisen. The comparison shows fairly conclusively that both the OH^- -group and the H-atoms are only slightly active along the reaction coordinate. The reaction rate is actually controlled by the rupture of the methyl-carboxyl bond. Mass-spectrometric analyses established that the gaseous products of pyrolysis of CH_3COONa do not contain molecules of ethane. No C^{14} atoms were detected in the resulting sodium carbonate. These experiments provide additional proofs for the assumption that pyrolysis of CH_3COONa takes place by a heterolytic mechanism. (auth)

18835

THE INFLUENCE OF LIGHT ON THE ABSORPTION SPECTRA OF URANYL NITRATE SOLUTIONS IN TRIBUTYLPHOSPHATE. Stefan Minc and Teresa Bryl (Univ. of Warsaw). *Nukleonika* **5**, 33-45(1960). (In Polish)

The influence of concentration and added substances on the course of change of the absorption spectrum of uranyl nitrate solutions due to light was investigated. It was found that: 1. The uranyl nitrate, being present in greater amounts, can stop the development of photochemical reactions. Under the conditions of this investigation a concentration of 0.03 mol/l was found to be sufficient. 2. In solutions containing smaller amounts of uranyl nitrate, the following acids act as inhibiting agents: nitric, perchloric, and hydrochloric. From the fact that HCl reveals an inhibiting action it is seen that oxidizing properties are not important with this respect. The inhibiting action is probably due to the hydrogen ions, a fact which probably is in accordance with the concept of $\text{U}^{(v)}$ formation as a product of photochemical reaction. (auth)

10836

THE TRI-*n*-BUTYL PHOSPHATE (TBP)-DILUENT-HNO₃-H₂O SYSTEM. Wincenty Korpak and Czesław Deptuła (Inst. of Nuclear Research, Polish Academy of Sciences, [Warsaw]). *Nukleonika* 5, 63-71(1960). (In English)

The distribution of nitric acid between water and a 5% solution of TBP in mepasine was investigated in relation to the concentration of nitric acid in the aqueous phase. The experiments revealed the oxonic character of the extraction of nitric acid with TBP and the possibility of the existence of complexes TBP·HNO₃, TBP·2HNO₃, TBP·3HNO₃, and, probably TBP·4HNO₃. The formation of a third phase was noted to form at 17.1 to 19.8 M HNO₃, and its approximate composition was determined. TBP was found to dissolve in 95% nitric acid to form one phase. This was taken as a basis for developing a rapid method for approximate quantitative determination of TBP in mepasine. (auth)

10837

STUDIES ON THE SYSTEM TBP-HClO₄-H₂O. Sławomir Siekierski and Rajmund Gwóźdź (Inst. of Nuclear Research, Warsaw). *Nukleonika* 5, 205-17(1960). (In English)

The concentration, ionization, hydration, and activity coefficients of perchloric acid in tributylphosphate, as a function of the concentration of acid in the equilibrium aqueous phase, were determined. The influence of diluent on the partition coefficient was also investigated. The results are discussed in terms of the most probable structure for the extracted ion-pair. (auth)

10838

INVESTIGATION OF ETHYLENEDIAMINETETRAACETATE (EDTA) COMPLEXES OF THE ALKALINE EARTHS BY ION EXCHANGE. N. N. Matorina and N. D. Safonova. *Zhur. Neorg. Khim.* 5, 313-20(1960) Feb. (In Russian)

The composition and instability constants of Ca²⁺ and Sr²⁺ EDTA complexes in solution were determined by ion-exchange studies. At a pH of 3.66 to 5.35 with a tenfold excess of complexing agent the complexes formed are [SrY]²⁻ ($K = 5.21 \times 10^{-8}$), [SrHY]¹⁻ ($K = 1.26 \times 10^{-2}$) and [SrH₂Y]⁰ ($K = 0.11$). The relative concentrations of the complexes depends on the pH. With a ratio of metal to addend of approximately one at a pH of 3.10 to 4.90 the calcium complexes formed are [CaY]²⁻ ($K = 3.58 \times 10^{-11}$) and [Ca₂Y]⁰ ($K = 2.99 \times 10^{-13}$) whose relative concentrations vary with a change in pH. The values for the instability constants obtained for the Ca²⁺ and Sr²⁺ EDTA complexes are close to the corresponding values obtained by Schwarzenbach and Ackermann. (TTT)

10839

THE COMPOSITION AND STRENGTH OF FLUOFERRATE AND FLUOBERYLLATE COMPLEXES IN SOLUTION BY SOLUBILITY DETERMINATIONS. I. V. Tananaev and A. D. Vinogradova. *Zhur. Neorg. Khim.* 5, 321-6(1960) Feb. (In Russian)

Similar to aluminum, solutions of ferric and beryllium salts were found to be excellent solvents for slightly soluble fluoride precipitates due to the formation of fluoride complexes. Thus, the solubility of CaF₂ in ferric nitrate solutions increases by a factor of up to 2000 as compared to the solubility of CaF₂ in water. Data obtained from a study of the solubility under varying conditions can serve to establish directly the composition of the complex and as a means of calculating the instability constants of the complexes. The results can be improved by taking into account the ionic strength of the medium. The solubility of CaF₂ was investigated in solutions of FeX₃ (X = NO₃, Cl, $\frac{1}{2}$ SO₄) in the presence of the anions Cl⁻, SCN⁻ and F⁻. From the results the value of the instability constant

for FeF₂⁺ was approximately 1×10^{-6} and for FeF₂⁺ it was $1-2 \times 10^{-9}$. On the basis of data on the solubility of CaF₂ in solutions of Be(NO₃)₂ in the presence of NaF the instability constant for BeF⁺ was calculated as 2.3×10^{-6} and for BeF₂ as 4×10^{-3} . (TTT)

10840

EVALUATION OF VARIOUS COMPLEXING AGENTS IN THE PREPARATION OF ENRICHED CONCENTRATES OF RARE EARTHS OF THE YTTRIUM GROUP. D. I. Ryabchikov and N. S. Vagina (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 356-8(1960) Feb. (In Russian)

Previously rare earths of the yttrium group were separated into separate fractions with the use of EDTA as a complexing agent. The possibility of using other organic acids such as acetic, malonic, tartaric, lactic, citric, and nitrilotriacetic acids was investigated. The amount of complexing agent was calculated from the content of the last five rare earths of the yttrium group (Ho-Lu). The pH of the solution was maintained as high as possible (from 3.5 to 4.5) without actually precipitating the basic rare earth salt. Ammonium oxalate was used as the precipitant. Y⁹¹ and Tu¹⁷⁰ were used as tracers to follow the behavior of yttrium and the heavy rare earths, respectively. It was found that acetic acid and malonic acids formed very weak complexes with the rare earths. Nitrilotriacetic, tartaric, citric, and lactic acids formed strong complexes with the rare earths. Lactic and citric acids were the most effective in separating yttrium from the heavier rare earths. In this regard the separation of yttrium from thulium is much sharper with lactic acid than it is with citric acid. (TTT)

10841

PHYSICO-CHEMICAL INVESTIGATION OF THE REACTION OF THORIUM NITRATE WITH PHENYLACETIC ACID. K. N. Kovalenko and M. N. Tarasova (Rostov-on-Don State Univ., USSR). *Zhur. Neorg. Khim.* 5, 385-92 (1960) Feb. (In Russian)

If continuous measurements of some physical property are performed on a reacting mixture and a plot is made of "composition versus physical property," it is frequently possible to determine the composition of the products formed from the reaction. Thus, it was established by measurements of electrical conductivity, pH, and surface tension that thorium nitrate reacts with phenylacetic acid to form an insoluble normal salt with the composition Th(C₆H₅CH₂COO)₄. No other compound could be found. The proposed formula for thorium phenylacetate was confirmed by analyzing the precipitate for thorium, carbon, and hydrogen. It was shown that the solid Th(C₆H₅COO)₄ is converted to a thorium oxide hydrate at a pH of 11.3 on treatment with a dilute solution of NaOH. (TTT)

10842

URANYL ION COMPLEX WITH 8-OXYQUINOLINE. M. P. Pavlovskaya and I. M. Reibel' (Kishinev Agricultural Inst., USSR). *Zhur. Neorg. Khim.* 5, 393-5(1960) Feb. (In Russian)

In the presence of excess pyridine 8-oxyquinoline does not form a precipitate with the uranyl ion but rather a dark red solution. The working solutions were an aqueous 0.075 M uranyl acetate solution, a 0.075 M 8-oxyquinoline solution in 2.5 M CH₃COOH and pyridine. On mixing varying amounts of uranyl acetate and 8-oxyquinoline the maximum optical density was noted at a ratio of uranyl ion to oxyquinoline = 1:1. The pyridine in the mixture was held constant at 50 per cent. The maximum optical density was noted at a pH of 7.0 with a sharp drop in optical density

taking place on changing the pH from 7.0 to 6.4. The relative intensity of the color falls off on dilution so that it is concluded that the 8-oxyquinoline uranyl complex is a weak one. A potentiometric titration with NaOH confirmed the fact that the ratio of uranyl ion to 8-oxyquinoline in the complex = 1:1. 15 references. (TTT)

18843

EXTRACTION ABILITIES OF MIXED SOLVENTS. V. M. Vdovenko and A. S. Krivokhatski. *Zhur. Neorg. Khim.* **5**, 494-7(1960) Feb. (In Russian)

The addition of inert solvents to organic extractants was used more and more in the solution of many practical and theoretical problems. The composition of rare earths extracted by tributylphosphate from nitric acid was determined by varying the concentration of organic extractant and noting the change in extractability. For extraction of a component with a mixture of extractants S_1 and S_2 it would be expected that the extraction ability of the mixture would be additive, that is, that the extraction of a component A by each solvent is independent of the presence of the other solvent. However, in the majority of the cases the effects are not additive but synergistic. Thus, the extraction of nitric acid by a mixture of diethyl ether and acetophenone from 1.0 N HNO_3 is higher than that calculated on the assumption of additivity of the components of the solvent mixture. Many other solvent mixtures such as diethyl ether-isoamyl alcohol, acetophenone-heptyl alcohol, and butylacetate-hexyl alcohol behave similarly. The explanation of this non-additivity can be found in the formation of mixed solvates of the substance A of the type $A \cdot nH_2O \cdot n'S_1 \cdot n''S_2$. If the formation of these mixed solvate complexes is taken into account, it can be shown that the experimental data on the extraction of nitric acid by a mixture of dibutyl ether and $\beta\beta'$ dichlorodiethyl ether is in satisfactory agreement with calculated values. It is pointed out that the extraction of uranyl nitrate by various solvent mixtures is non-additive, for example, by diisopropyl ether-dichlorodiethyl ether, diethyl ether-acetophenone, and by isoamyl alcohol-methyl isobutyl ketone. (TTT)

18844

SOLUBILITY OF DIFFICULTLY SOLUBLE ALKALI METAL HETEROPOLYACIDS. V. I. Spitsyn and N. B. Babaev (Lomonosov Moscow State Univ.). *Zhur. Neorg. Khim.* **5**, 580-5(1960) Mar. (In Russian)

The phosphomolybdates and silicomolybdates have been used in the analyses and preparation of cesium and rubidium, but available solubility data are limited. A study of the solubility at 25°C in 0.3 N HCl was made on the di- and tri-potassium, the tri-cesium, and the tr-rubidium salts of phosphotungstate, the tri-potassium, cesium, and rubidium salts of phosphomolybdate, the tetra-rubidium and cesium salts of silicotungstate, the tri-rubidium and cesium salts of silicomolybdate, and the tetra-rubidium salt of silicomolybdate. It was established that the tri-potassium salt precipitates out of aqueous solution, the di-potassium salt with some tri-salt as an impurity from 0.3 N HCl, and the di-potassium salt alone from 1.0 N and 5.0 N HCl, when phosphotungstate is used as the precipitating agent. In 0.3 N HCl, rubidium and cesium form tri-salts with phosphotungstate, a mixture of the di- and tri-salts with phosphomolybdate, and the tri-salts with silicomolybdate. The solubility of the phosphotungstates, phosphomolybdates, silicotungstates, and silicomolybdates decreases in going from K to Rb to Cs. For heteropolyacid salts containing the same alkali metal element (K, Rb, or Cs), a decrease in valence and an increase in size of the central atom ($P^{5+} \rightarrow Si^{4+} \rightarrow Ge^{4+}$) results in an increase in solubility. Substitution of tungsten by molybdenum in the heteropolyphosphate

salts leads to an increase in solubility. With the heteropolysilicate salts the substitution of Si by Mo leads to a decrease in solubility. (TTT)

18845

APPLICATIONS OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN ORGANIC CHEMISTRY. L. M. Jackman. International Series of Monographs on Organic Chemistry. Volume 5. New York, Pergamon Press, 1959. 144p. \$5.50.

Applications were compiled for those organic chemists who wish to employ nuclear magnetic resonance but who do not wish to make a detailed study of the fundamental principles involved. Accordingly, the theory of nuclear resonance is developed non-mathematically and to an extent sufficient for those needs. Much of the presentation is devoted to correlated data and empirical theories which constitute the basis of the application of NMR spectroscopy to organic chemistry. (B.O.G.)

18846

FLUIDIZATION AND FLUID-PARTICLE SYSTEMS. Frederick A. Zenz and Donald F. Othmer. Reinhold Chemical Engineering Series. New York, Reinhold Publishing Corporation, 1960. 522p. \$15.00.

The results of over 17 years of research and study are compiled in a convenient, centralized information source on all major aspects of fluid-particle technology. It covers modern developments in fluid-solids processing, particularly the moving bed techniques, fluidization, and transport reactors. The breadth of coverage for any one field is, in most instances, sufficient to answer a problem, point out recognized experimental or theoretical bases, and to refer to sources of a more detailed nature. The entire subject matter is arranged in a logical order with the particular purpose of utilizing it as a text for graduate-level courses devoted to engineering design of particle-fluid processes. (B.O.G.)

Analytical Procedures

18847 A/AC.82/G/L.301 & Add. 1

Sweden. Försvarets Forskningsanstalt, Stockholm. DETERMINATION OF Sr^{90} IN DRIED MILK, MILK AND SOIL. Sten Häggroth. Jan. 9, 1959. 28p.

Measurements were made of the levels of Sr^{90} in samples of dried milk, fresh milk, and soil collected in Sweden prior to 1959. Data are tabulated. The importance of the entrance of Sr^{90} into the food chain is discussed. (C.H.)

18848 AERE-AM-63

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England.

THE DETERMINATION OF CHROMIUM IN ZIRCONIUM METAL AND ZIRCALOY II. P. T. S. Sandon. Mar. 1960. 6p. BIS.

The sample is dissolved in HF which is removed by fuming with H_2SO_4 . After oxidation with $KMnO_4$ the Cr is determined spectrophotometrically by means of diphenylcarbazide. The method is applicable to samples containing 5 to 2000 ppm. (J.R.D.)

18849 AERE-AM-64

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England. THE DETERMINATION OF RADIOIODINE. G. J. Hunter and M. Perkins. May 1960. 12p. BIS.

The radioiodine with added iodine carrier is oxidized to periodate with hypochlorite in alkaline solution. After

acidification of the solution, hydroxylamine hydrochloride is used to reduce the periodate to iodine which is extracted into carbon tetrachloride from which it is then extracted as iodide with sulfurous acid. Further purification involves another carbon tetrachloride extraction cycle in which nitrite is used to oxidize iodide to iodine. The iodine is finally precipitated as silver iodide which is then counted. (auth)

18850 AERE-R-3261

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE ESTIMATION OF HYDROGEN FLUORIDE IN MIXED GAS SYSTEMS BY INFRA-RED SPECTROSCOPY. A. M. Deane. Mar. 1960. 30p. BIS.

The variation of the infrared absorption near 2.5 microns of hydrogen fluoride was studied for the systems HF, HF/N₂, HF/Ar, HF/N₂/Ar, HF/H₂O/N₂, HF/UF₆, and HF/UF₆/N₂ at both 20°C and 60°C. Pressure broadening coefficients for many of these systems were derived but the room temperature results from the last system could not be simply expressed; an empirical relation for the broadening coefficient is given for UF₆ at 60°C. In general the results confirmed the earlier studies at higher temperatures by Smith. Both handling and spectroscopic techniques are described and the application to the analysis of HF in a gas stream is discussed. (auth)

18851 AERE-R-3264

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE POTENTIOMETRIC DETERMINATION OF PLUTONIUM. A. J. Fudge, A. J. Wood, and M. F. Banham. Apr. 1960. 19p. BIS.

A method is described for the determination of plutonium in the range of from 1 to 10 mg. The plutonium, in sulfate solution, is reduced to the trivalent state by the addition of excess chromous sulfate in 1M sulfuric acid. The excess chromous sulfate is air oxidized until a steady potential is observed from the platinum/calomel electrodes. The plutonium(III) is then oxidized to plutonium(IV) with a standard solution of ceric sulfate delivered from an Agla micrometer syringe burette. A procedure is described for the separation of plutonium from elements that would cause interference with the titration. A precision of $\pm 0.2\%$ (σ) of plutonium is attained in the range of from 2 to 10 mg with a similar accuracy. (auth)

18852 CEA-1385

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

EXTRACTION ET DOSAGE DE L'HYDROGENE DANS L'URANIUM ET LE ZIRCONIUM. (Extraction and Determination of Hydrogen in Uranium and Zirconium). L. Champeix, G. Coblence, and R. Darras. 1959. 29p.

The method of desorption under vacuum at high temperatures in the solid phase, which gives good results in the case of steels, was applied to uranium and zirconium. In these two metals hydrogen is found mainly in the form of hydride. It is chiefly a question of determining the most suitable temperature and the heating time necessary to obtain an almost total extraction of hydrogen. Two considerations must be taken into account in the choice of temperature. It should be such that on the one hand the hydride decomposes rapidly and completely at the reduced pressure applied, and on the other hand the diffusion of hydrogen through the metal takes place fairly quickly. The apparatus and the method used are described; sys-

tematic tests have led to the adoption of temperatures of 650°C for uranium and 1050°C for zirconium. (auth)

18853 NAA-SR-Memo-1552

North American Aviation, Inc., [Downey, Calif.]. SODIUM VAPOR DETECTION TEST. D. L. Whitlock. Jan. 9, 1956. 8p. OTS.

The Westervelt method of sodium vapor detection (passing an inert gas into the area presumed to contain sodium vapor and bubbling the gas through water containing thymol blue indicator) was evaluated for use in detecting leaks in the SRE control rods. The method was found unsatisfactory for the proposed use. (C.J.G.)

18854 NP-8834

Canada. Dept. of Mines and Technical Surveys, Mines Branch.

THE DETERMINATION OF IRON IN URANIUM BEARING MATERIALS BY USE OF AN ETHYL ACETATE EXTRACTION AND A COLORIMETRIC BATHOPHENANTHROLINE PROCEDURE. R. J. Guest and F. P. Roloson. Dec. 10, 1956. 21p. (TR-137/57).

Ferrous iron forms a colored complex with 4, 7-diphenyl-1, 10-phenanthroline (bathophenanthroline) which was made the basis of a colorimetric method for the determination of microgram amounts of iron in material of varying uranium content. Of the commonly occurring elements, the only interfering element found was copper. The effect of this contaminant was eliminated by extracting the iron by means of ethyl acetate from a solution strongly acid in hydrochloric acid. The efficiency of this ethyl acetate extraction procedure was investigated and its use as a substitute for longer and more involved separations is illustrated. A preliminary investigation was carried out on the application of the bathophenanthroline method to the direct determination of ferrous iron on typical mill solutions. (auth)

18855 PGR-91(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

ANALYTICAL METHODS FOR THE INSPECTION OF AMMONIUM NITRATE. Mar. 1960. 22p.

The acidity or alkalinity and the fluoride content are determined titrimetrically. The boron, iron, phosphorus, and silicon are determined absorptiometrically. The nitrite is estimated colorimetrically and the chloride and sulfate turbidimetrically by visual comparison with standards. The nonvolatile residue, volatile matter, and water insoluble matter are determined gravimetrically. (auth)

18856 PGR-92(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

ANALYTICAL METHODS FOR THE INSPECTION OF OXALIC ACID. Mar. 1960. 17p. BIS.

Oxalic acid is assayed titrimetrically and the boron, iron, and silicon contents determined absorptiometrically. The chloride content is determined turbidimetrically and the sulfate, water insoluble matter, and the residue gravimetrically after ignition. (auth)

18857 PGR-95(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM IN URANIUM PLANT SOLUTIONS (LANTHANUM FLUORIDE CO-PRECIPIATION FROM AMMONIUM SULPHATE SOLUTION). Mar. 1960. 5p.

Plutonium is co-precipitated with lanthanum fluoride from a solution containing ammonium sulfate. The ammonium sulfate complexes the uranyl ion and prevents the precipitation of uranium as fluoride. The precipitate is mounted evenly on a stainless steel counting tray and the α -activity is measured using standard α -scintillation counting equipment. The equipment is calibrated against standard sources. (auth)

18858 PGR-98(W)

United Kingdom Atomic Energy Authority. Production Group. [Chemical Services Dept.], Windscale, Sellafield, England.

ANALYTICAL METHOD FOR THE DETERMINATION OF CAESIUM-137 IN URINE. Apr. 1960. 10p. BIS.

The sample, with added cesium carrier, is evaporated to dryness in the presence of nitric acid, ashed, and the residue dissolved in hydrochloric acid. The cesium is precipitated as silico-tungstate, which is dissolved and the solution purified by ion-exchange resins. The cesium is precipitated as perchlorate, mounted on a stainless steel counting tray and the activity measured with a Geiger-Mueller tube. (auth)

18859 PGR-104(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

METHODS FOR THE CONCENTRATION OF IMPURITIES FROM WINDSCALE RAW MATERIALS PRIOR TO SPECTROGRAPHIC ANALYSIS BY THE IRON FLUX TECHNIQUE. Apr. 1960. 7p. BIS.

The samples are decomposed by evaporation, ignition, or bromination, and the residues treated with nitric and sulfuric acids and sucrose. The mixture is finally volatilized and ignited. For potassium bromide and bromate and calcium fluoride, certain impurities are isolated by coprecipitation. The residues are spectrographically analyzed. (auth)

18860 PGR-113(W)

United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England.

ANALYTICAL METHOD FOR THE SPECTROGRAPHIC ANALYSIS OF IMPURITIES IN SODIUM DICHROMATE. Apr. 1960. 9p.

The sample is mixed with ammonium sulfate and analyzed using a large quartz spectrograph on copper electrodes in a d-c arc. (auth)

18861 PGR-116(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

ANALYTICAL METHODS FOR THE INSPECTION OF TRIBUTYL PHOSPHATE. May 1960. 16p. BIS.

The tributyl phosphate is determined by hydrolysis and volumetric determination of the phosphoric acid produced. Ionizable chloride is extracted and determined volumetrically. Total chloride is determined by reacting with sodium and determining the chloride volumetrically. Butyl alcohol is determined by measuring the amount of acetic anhydride required for esterification. Phosphoric acid is determined gravimetrically. Ammonia is determined volumetrically after distillation from alkaline solution. Dibutyl phosphate and monobutyl phosphate are determined by titration to two indicators and calculations involving the ammonia and phosphoric acid results. (auth)

18862 PGR-120(CA)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Capenhurst, Ches., England.

ANALYTICAL METHOD FOR THE DETERMINATION OF THE ALPHA-ACTIVITY DUE TO URANIUM IN AQUEOUS SLUDGES. May 1960. 6p. BIS.

To determine the alpha activity in aqueous sludges due to uranium, the uranium is leached from the sludge, ammonium and ferric nitrates are added to the solution, and the uranium is subsequently extracted into di-ethyl ether. The alpha activity is determined using a scintillation counter. The limit of detection of the method is 5 dpm/g of dried sludge. (C.J.G.)

18863 PGR-126(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

THE DETERMINATION OF URANIUM IN URANYL NITRATE SOLUTIONS (CERIC SULPHATE TITRATION). June 1960. 5p. BIS.

A method for the determination of uranium in uranyl nitrate solutions was developed using ceric sulfate titration. After uranyl nitrate was heated with sulfuric acid to remove the nitrate, the uranium was reduced to the tetravalent state with aluminum. Then the uranium was titrated with standard ceric sulfate solution, in the presence of phosphoric acid, using ferroin as an internal indicator. (M.C.G.)

18864 SCS-R-117

Gt. Brit. Springfields Works, Springfields, Lancs, England. THE USE OF SODIUM CHLORIDE AS CARRIER IN THE SPECTROGRAPHIC ESTIMATION OF LITHIUM, POTASSIUM AND BARIUM IN URANIUM-BASE MATERIALS BY THE CARRIER DISTILLATION METHOD. P. Servin and R. Franklin. Mar. 10, 1950. 18p.

18865 TID-6143

Argonne National Lab., Ill.

THE DETERMINATION OF SOLUBLE POISON CONCENTRATIONS IN H_2O (thesis). Rodney A. Mattson. 1957. 64p. OTS.

Submitted to Michigan Coll. of Mining and Tech.

A soluble poison is a water soluble chemical compound which possesses a high thermal neutron absorption cross section. It is added to the water moderator of a boiling reactor for certain control purposes. A method is described which will continuously monitor the concentration of the poison in the moderator. The theory of operation follows that of the transmission principle in which a neutron beam is attenuated by the medium through which it passes. Poisoned moderator is circulated through a small tank surrounded by paraffin while a BF_3 proportional counter detects neutrons which diffuse through the water from a Po-Be neutron source. The relationship between counting rate and poison concentration is essentially linear in the concentration range which is considered (0 to 0.008 molar boric acid). Calibration of several counter arrangements and positions is presented. Data are given for effects of temperature, liquid level, and amount of poison on counting rate. Three poisons, gadolinium, cadmium, and boron were used in the experiment. This analytical method can yield results commensurate with counting error which will decrease as counting time is increased. One drawback of using BF_3 proportional counters is that their operating characteristics shift with high counting rates and care must be taken to insure operation on the proper plateaus. Accuracies approaching 1% have been attained which can be achieved with the continuous arrangement proposed. (auth)

18866 WAPD-M(GLA)-830

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

THE DETERMINATION OF URANIUM IN PWR ZIRCALOY

BASE FUEL ALLOY. G. W. Goward, B. N. Nelson, and V. R. Wiederkehr. Apr. 6, 1960. 8p. Contract AT-11-1-GEN-14. OTS.

A method for the determination of 3 to 10% uranium in zirconium and Zircaloy is described. Tungsten in excess of 1000 micrograms interferes. No other interfering elements are normally found in such alloys. (J.R.D.)

18867

SCANDIUM, CHROMIUM AND EUROPIUM IN STONE METEORITES BY SIMULTANEOUS NEUTRON ACTIVATION ANALYSIS. George L. Bate, Herbert August Potratz, and John R. Huizenga. *Geochim. et Cosmochim. Acta* 18, 101-7(1960) Jan.

Analyses of 5 chondrites by simultaneous neutron activation yielded average concentrations of $(9.4 \pm 0.3) \times 10^{-6}$ g. Sc/g. meteorite, $(2.2 \pm 0.1) \times 10^{-3}$ g. Cr/g. meteorite and $(7.8 \pm 0.3) \times 10^{-8}$ g. Eu/g. meteorite. Following the assumptions of Urey, these results lead to cosmic abundances of 32, 6400, and 0.078 (per 10^6 Si atoms) for Sc, Cr, and Eu, respectively. Except for lowering the Eu abundance by a factor of 2, the Suess-Urey abundances based on chondrite analyses are not materially altered. The present results are consistently lower than the solar abundances reported by Aller, approaching nearly an order of magnitude in the case of Eu. The concentrations of the 3 elements in 2 achondrites varied markedly; the Sc/Eu atom ratio, for example, decreased from an average of 410 for the chondrites to 190 for Nuevo Laredo but increased to 5700 for Johnstown, Colorado. (*GeoScience Abstr.* 2, No. 5, 1960)

18868

POLAROGRAPHIC DETERMINATION OF HEXAVALENT URANIUM IN URANIUM TETRAFLUORIDE. Kenji Motojima, Hiroshi Okashita, and Kazuo Katsuyama (Japan Atomic Energy Research Inst., Tokyo). *J. Atomic Energy Soc. Japan* 2, 313-16(1960) June. (In Japanese)

An analytical method is proposed for the polarographic determination of uranium(VI) in uranium tetrafluoride. A sample weighing about 500 mg is treated with 20 ml of 0.1M NaF solution using a magnetic stirrer, and is subjected to centrifugation. Two milliliters of the supernatant solution and 5 ml of supporting electrolyte solution (1.3 M HOAc + 0.7 M NH_4OAc + 0.2 M BeSO_4) are taken into a 10-ml volumetric flask and the resulting solution is diluted to the mark with water. Uranium(VI) in the solution is determined polarographically by referring to the standard calibration curve. For the purpose of suppressing the dissolution of uranium(IV) into the solution, NaF is used at the time of the sample digestion. The acetate buffer solution keeps the pH of the solution at 5 and Be^{2+} ion removes the interference of F^- ion in the polarographic measurements. Al^{3+} can be used instead of Be^{2+} for the same purpose. By this method as small as 0.05% of uranium(VI) in uranium tetrafluoride can be readily determined. (auth)

18869

AN IMPROVED METHOD FOR DETERMINATION OF RADIOACTIVE IODINE IN RAINWATER AND URINE.

Zbigniew Jaworowski (Inst. of Nuclear Research, [Polish Academy of Sciences, Warsaw]). *Nukleonika* 5, 81-86 (1960). (In English)

A procedure for determining radioiodine in urine and rainwater is presented which depends on isotopic exchange between stable and radioactive iodine, on asbestos mats impregnated with silver iodine. The detection limit of this method is 5 μCi of I^{131} in one liter sample and the mean recovery is 97%. (auth)

18870

RADIOMETRIC ANALYSIS OF VOLATILE ORGANIC COMPOUNDS, MARKED WITH C^{14} AND H^3 , BY VAPOUR PHASE CHROMATOGRAPHY. Fulvio Cacace and Inam-Ul-Haq (Centro di studio per la Chimica Nucleare, Rome). *Ricerca sci.* 30, 501-8(1960) Apr. (In Italian)

A method of analysis permitting the gas-chromatographic separation and quantitative measurement of the radioactivity of organic compounds containing carbon-14 or tritium is described. The equipment employed permits the determination of carrier-free trace substances through the radioactivity. (auth)

18871

SPECTROPHOTOMETRIC METHOD OF ZIRCONIUM DETERMINATION BY AMYGDALIC ACID. V. M. Peshkova, N. V. Mel'chakova and A. B. Urazbekova. *Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim* No: 6, 150-5(1959). (In Russian)

Small quantities of zirconium salts (0.05 mg) were determined by a spectrophotometric method with amygdalic acid. Conditions for zirconium separation from thorium (1:5) and titanium (1:10) are described. The composition of ammonium solution of zirconium myndalate shows the compound composition $(\text{NH}_4)_2\text{Zr}(\text{C}_8\text{H}_8\text{O}_3)_4$. (R.V.J.)

18872

DETERMINATION OF FREE CARBON IN CHROMIUM CARBIDE. T. Ya. Kosolapova and S. V. Radzikovskaya (Inst. of Cermets and of Special Alloys, Academy of Sciences, USSR). *Zavodskaya Lab.* 26, 138-9(1960). (In Russian)

It is of interest to know the exact amount of free carbon in chromium carbide because its dissolution in the cementing metal increases the brittleness of the material. The previous method based on the differential solubility of carbides and C in HCl is subject to errors and is too protracted while not being applicable for the determination of very small amounts of free C. A new method was developed on the basis of high temperature oxidation of the carbide-free C mixture. It was found that under slow heating of the mixture in a stream of O_2 the oxidation of the carbide itself does not start until 700°C. Keeping the temperature at 600°C for 30 to 40 min it was found that all the carbon of mixtures of Cr_3C_2 or Cr_7C_3 and charcoal was completely burned. The actual C content of the mixture was determined by analytical methods from the CO_2 concentration of the off-gases. The least-square error of the method was 2%. (TTT)

18873

DETERMINATION OF TITANIUM, TANTALUM, AND NIOBIUM IN MIXTURES OF CARBIDES. V. G. Shcherbakov and Z. K. Stegendo (All-Union Scientific Research Inst. of Hard Refractories, USSR). *Zavodskaya Lab.* 26, 139-42 (1960). (In Russian)

Analysis of mixed carbides containing about 15% Ti, up to 6% Ta, 2% Nb, 5 to 8% Co, 0.1 to 0.5% V, and up to 70 to 75% W was performed by developing a novel method based on the differential solubility of the complex oxalates of Ti, Ta, and W. The Ti and Ta complexes formed by precipitation from sulfate solutions are unstable. The Ti was determined volumetrically by reduction with Zn amalgam, while the Ta was precipitated with β -naphthoquinoline. Detailed analytical instructions are given. (TTT)

18874

SPECTROPHOTOMETRIC STUDY OF THE REACTION OF ZIRCONIUM WITH METHYL THYMOL BLUE. V. F. Luk'yanov and E. M. Knyazeva. *Zavodskaya Lab.* 26, 263-5(1960). (In Russian)

Methyl thymol blue which is already used for the complexometric titration of a number of elements, forms with Zr in acid medium a bluish-violet complex with an absorption maximum at 580 m μ , while on dissolution of the complex the solution turns yellow and has an absorption maximum at 440 m μ . Solutions of 0.1 to 1 N HCl yields the best results. The reaction takes place fast and the compound remains stable for several days. Prior to the complex formation, the Zr containing solution must be brought to boiling with HCl, HNO₃, or H₂SO₄. Although the presence of a large number of elements does not interfere in the reaction even in concentrations ten times higher than that of Zr, others such as Bi³⁺, Sn⁴⁺, Ti⁴⁺, and Fe³⁺ and certain anions, such as PO₄³⁻, F⁻, or C₂O₄²⁻ must be eliminated. The sensitivity is 0.2 γ /ml of Zr. (TTT)

18875

PHOTOMETRIC DETERMINATION OF URANIUM WITH THE REAGENT ARSENAZO. V. I. Kuznetsov and I. V. Nikol'skaya (Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zavodskaya Lab. **26**, 266-9(1960). (In Russian)

A new photometric method for determining U was developed on the basis of its reaction with the reagent arsenazo (forms a blue complex with hexavalent U and a bluish-violet one with tetravalent). The sensitivity of the reaction makes it possible to determine the U content of ores on an order of magnitude of 0.001%. The reaction of the tetravalent U takes place at pH = 1.5 and is more selective than that of UO₂²⁺ because in this acidity range Fe²⁺, Be²⁺, Al³⁺, rare earth elements, and some others do not react with the reagent, as they hydrolyze at higher pH values. KI was used with good success for reducing the hexavalent U, after its HCl solution was evaporated to dryness. The presence of Mo, V, and Cr exerts an unfavorable influence on the color formation. At larger pH values the specificity of the reaction decreases considerably. The absorption maximum of the complex lies at 555 m μ . If the specimen contains only gamma quantities of U, it must be concentrated by selective precipitation prior to the photometric determination. (TTT)

18876

PHOTOMETRIC DETERMINATION OF THORIUM IN ORES WITH ARSENAZO III. S. B. Savvin and V. B. Bagreev (Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zavodskaya Lab. **26**, 412-15(1960). (In Russian)

Th and certain other tetravalent elements such as U and Zr form internal complexes with the reagent arsenazo III (an organic sulfocompound containing As) which are stable in strong acids, sulfates, and phosphates. Th was determined photometrically in HCl solutions ranging from 0.01 to 10 N without finding it necessary to remove the sulfates, phosphates, or oxalates. The method was especially useful for working at concentrations from 0.05 to 1 γ of Th in the analysis of minerals such as alaskite granite, syenite, and nordmarkite. (TTT)

18877

COLORIMETRIC DETERMINATION OF ZIRCONIUM BY MEANS OF ITS REACTION WITH ARSENAZO III. V. G. Goryushina and E. V. Romanova (State Research and Planning Inst. of the Rare Metal Industry, USSR). Zavodskaya Lab. **26**, 415-18(1960). (In Russian)

The reagent arsenazo III (1,8-dioxynaphthalene-3,6-disulfonate-2,7-bis-azo-2-phenyl arsenic acid) forms bluish-violet complexes with Zr even in a 2 N HCl solution, the optical density of which remains stable through a wide pH range. As in the case of the pyrocatechin violet method,

the Zr must be transformed into a homogeneous zirconyl solution by bringing to boiling with HCl. The best range for the determination lies between 5 and 30 γ per 50 ml of sample. The method is highly selective: relatively high concentrations of Al, Fe, Ti, and Sn could be tolerated thus making it useful in the rapid determination of Zr in ores without first separating the other elements. (TTT)

18878

DETERMINATION OF ZIRCONIUM IN TITANIUM AND ITS ALLOYS WITH PYROCATECHIN VIOLET. Yu. A. Chernikhov, B. M. Dobkina, and E. I. Petrova. Zavodskaya Lab. **26**, 529-31(1960). (In Russian)

The absorption maximum of the Zr complex with pyrocatechin violet which lies at a wavelength of 550 m μ , makes it possible to determine this element in the concentration range 0.2 to 1 γ /ml, as opposed to the conditions prevailing at higher Zr concentration, when the absorption maximum shifts to 620 m μ . The precision of the method is about 3% while its sensitivity when used for determining this element in Ti and in TiF₄ is 0.003%. The Zr determination can be performed immediately after dissolving the alloy in HCl. The presence of Mo, Al, or Nb does not interfere. (TTT)

18879

DETERMINATION OF SMALL AMOUNTS OF PHOSPHORUS IN METALLIC CHROMIUM. A. A. Fedorov and F. V. Linkova (Central Scientific Research Inst. of Ferrous Metallurgy, USSR). Zavodskaya Lab. **26**, 535-6(1960). (In Russian)

The most convenient method for the determination of very small amounts of P in Cr is based on the separation of the P from the hexavalent Cr in alkaline medium by coprecipitation with Ca(OH)₂. Losses of P are minimized by dissolving the specimen in Br-saturated HCl. If the metal contains more As than P, it must be first driven off. The actual method is based on the formation of a phosphomolybdic heteropoly acid which is extracted with ether and is colorimetrically analyzed in the form of molybdenum blue. The precision of the method reaches $\pm 0.0002\%$ abs for concentrations ranging from 0.0002 to 0.0015% and 0.0005% abs for the 0.0015 to 0.01 concentration range. (TTT)

18880

DETERMINATION OF CADMIUM ADDITIONS IN NICKEL AND COBALT BY ION EXCHANGE METHODS. V. N. Pavlova and N. P. Strel'nikova. Zavodskaya Lab. **26**, 536-7(1960). (In Russian)

An anion exchange resin was used for absorbing complex Cd chloride from 2N HCl solution, under which condition Ni, Co, Cu, and Fe do not participate in the exchange. The Cd is desorbed with water and determined colorimetrically by the usual method. Although Zn and Pb are desorbed at the same time, it was found that up to 25 γ in the aliquot does not interfere with the analysis; if larger amounts of Zn are present, the Cd must be reextracted with tartaric acid. Similarly, the interference of Pb was counteracted by the addition of Rochelle salt. (TTT)

18881

THE SPECTRAL ANALYSIS OF RARE EARTH ELEMENTS. Sh. G. Melamed, S. M. Polyakov, and M. G. Zemskova (State Research and Design Inst. of Rare Metals Industry, USSR). Zavodskaya Lab. **26**, 554-6(1960). (In Russian)

A method is described for determining the elements in mixtures of rare earths. The superposition of lines of the mixture's spectrum was overcome by dilution with Y₂O₃ or CaCO₃. Yttrium was the standard in the first case and scandium in the second case. Dilution was to a factor of

1/20. A DFS-3 spectrograph, having a flat diffraction grating (1200 rulings/mm) and a reciprocal dispersion of 2 Å/mm was used. A description is given of the electrodes and the source arrangement. Best results were obtained when powder samples were vaporized directly in the anode channel. No fractional vaporization of calcium occurred. Three groups of standards were prepared, corresponding roughly to the probable contents of rare earth elements in ores and concentrates. Analytical line pairs and sensitivity of analysis are given in a table. A complete analysis is made through two series of spectrograms: one in the range 3050 to 3500 Å and the other in the range 3800 to 4250 Å. The mean square relative error of reproducibility was 5% for dilution with Y_2O_3 and 7% for dilution with $CaCO_3$. (TTT)

18882

A METHOD FOR RAPID ANALYSIS OF HAFNIUM IN ZIRCONIUM. V. A. Korneev. Zavodskaya Lab. **26**, 561-2 (1960). (In Russian)

A rapid method of analysis of zirconium for hafnium from hundredths of a percent to 100% is described. The method involves spectrophotometry using step attenuators. A spectroprojector was used to make possible visual identification of equal blackening of lines. A table of line pairs is given as well as a table of photometric comparisons made for the range of HfO_2 content in HfO_2-ZrO_2 from 0.03 to 99%. The spectrograph, type ISP-22, is described. The time required to analyze one sample is one-half hour while the time for five samples is less than one hour. The mean arithmetic error of a single analysis is about 15%. (TTT)

18883

THE DETERMINATION OF HAFNIUM IN ZIRCONIUM USING A SPECTROGRAPHIC METHOD. F. F. Gavrilov, M. I. Fedorovskaya, and N. K. Yakhimovich. Zavodskaya Lab. **26**, 563-4 (1960). (In Russian)

A spectrochemical method is described for the determination of hafnium in zirconium with concentration range 4.10^{-4} to $4.10^{-2}\%$. Six standards were prepared by mixing known quantities of spectroscopically pure hafnium and zirconium oxides. Their hafnium concentrations were 0.04, 0.013, 0.005, 0.002, 0.0008, and 0.0004%. The spectrograph employed is of the type ISF-22 with a slit width of 0.030mm. Line pairs for comparison used in this procedure were: ZrII, 2568, 873 and HfII, 2641, 406 Å. A plot of the logarithm of the hafnium concentration versus the change in line darkening is presented. The mean square error in the determination of hafnium concentration is about 5% in the range $8.10^{-4}\%$. (TTT)

18884

RADIOMETRIC DETERMINATION OF POTASSIUM. V. E. Bel'skii and O. K. Fomin (Lisichan Branch of the State Research Inst. of the Nitrogen Industry and Synthetic Organic Materials, USSR). Zavodskaya Lab. **26**, 707-9 (1960). (In Russian)

Absorption of K^{40} β particles is used in determining K in compounds, β absorption in completely absorbing layer is determined by the Z/A (atomic number: atomic weight) ratio of the material in the absorber, and accordingly the number of counts per min per % K is not constant. This was experimentally verified in mixtures of various pure K compounds and of KCl solutions with inert salts, determining the value of counts/min/% K from the activity and the K concentration of the specimens and deriving the value of $(Z/A)_{\text{effective}}$ from the correlation: $(Z/A)_{\text{eff}} = (Z/A)_i \cdot P_i/100$, where $(Z/A)_i$ refers to the atomic number: atomic weight ratio and P_i to the percentage of the con-

stituent elements. It was found that the value of counts min/% K is inversely proportional with $(Z/A)_{\text{eff}}$. The effect of the chemical nature of the components on the activity is slight, but if the specimens contain large amounts of H or heavy elements, a correction factor must be used for determining the activity K_2 of the unknown specimen, as derived from the relationship $K_2 = K_1 + 54 [(Z/A)_1 - (Z/A)_2]$, where the subscripts 1 and 2 refer to the reference standard and the unknown specimen, respectively. The factor was derived from experimental data by the least square method. Such a correction factor does not have to be used if the standard and the unknown material have similar $(Z/A)_{\text{eff}}$ values, as is the case in particular in the radiometric determination of K. (TTT)

18885

CATALYTIC OXIDATION OF IODIDE BY HYDROGEN PEROXIDE IN THE PRESENCE OF ZIRCONIUM. K. B. Yatsimirskii and L. P. Raizman. Zhur. Neorg. Khim. **5**, 593-8 (1960) Mar. (In Russian)

It is postulated that the zirconyl ion (ZrO^{2+}) forms a peroxy complex with hydrogen peroxide that reacts with iodide. It was found that the rate of oxidation of iodide by hydrogen peroxide is a linear function of the concentrations of iodide and zirconium in solution, but does not depend on the concentration of H_2O_2 in solution. The catalytic effect of zirconium in accelerating this reaction can be used to estimate small amounts of zirconium in pure solutions. Anions such as CH_3COO^- , $C_2O_4^{2-}$, $HC_4H_4O_6^-$, PO_4^{3-} , F^- , $EDTA^{4-}$, and SO_4^{2-} form complexes with zirconium which lower the rate of reaction. Mo(IV), W(VI), and Fe^{3+} are also effective catalysts. Hg^{2+} and Cd^{2+} form complexes with iodide which interfere with the reaction. Na^+ , K^+ , Al^{3+} , Mn^{2+} , Cr^{3+} , Ca^{2+} , Zn^{2+} , Ni^{2+} , Co^{2+} , Cl^- , ClO_4^- , SiO_3^{2-} , and NO_3^- have no effect on the catalytic reaction. The tests should be made in 1.0 N HCl or higher and the solutions should be aged, because at lower acidities zirconium tends to hydrolyze with the formation of polymers. (TTT)

General Inorganic and Physical Chemistry

18886 BNL-599

New Hampshire, Univ., Durham.
ABSORPTION SPECTRA IN FUSED SALTS. Final Report. Helmut M. Haendler. Jan. 15, 1960. 15p. For Brookhaven National Lab. Contract AT-30-2-GEN-16. Subcontract S-284. OTS.

The ultraviolet absorption spectra of eight anhydrous metal chlorides dissolved in a magnesium chloride-potassium chloride-sodium chloride eutectic have been observed at 430°C in the spectral region from 230 to 400 μ . The chlorides used were those of copper(II), nickel(II), cobalt(II), manganese(II), iron(III), uranium(III), uranium(IV), and uranyl. Spectra have also been measured in the visual region, 400 to 650 μ , for $CuCl_2$, $CsCuCl_3$, $CoCl_2$, Rb_2CoCl_4 , Cs_2CoCl_4 , $MnCl_2$, $NiCl_2$, $CsNiCl_3$, UO_2Cl_2 , and $Cs_2UO_2Cl_4$, dissolved in eutectic and, in some cases, dissolved in N,N-dimethylformamide. (auth)

18887 CEA-1382

France, Commissariat à l'Énergie Atomique, Centre d'Études Nucleaires, Saclay.
ÉTUDE DES CONSTANTES DES ÉQUILIBRES ISOTOP-
IQUES DU DEUTÉRIUM ENTRE L'EAU ET LES HYDRURES
DES MÉTALLOÏDES DE LA DEUXIÈME FAMILLE. (Isotopic Equilibrium Constants of the Deuterium Exchange

Between Water and Hydrides of Metalloids of the Second Group). Danièle Marx. 1960. 54p.

Thesis submitted to Univ. of Paris.

The equilibrium constant K was determined for each of the following isotope exchanges: $\text{SH}_2 + \text{OHD} \rightleftharpoons \text{SHD} + \text{OH}_2$, $\text{SeH}_2 + \text{OHD} \rightleftharpoons \text{SeHD} + \text{OH}_2$, and $\text{TeH}_2 + \text{OHD} \rightleftharpoons \text{TeHD} + \text{OH}_2$. In gaseous phase, statistical thermodynamics leads to the expression: $K = Z_{\text{OHD}} \cdot Z_{\text{RH}_2} / Z_{\text{OH}_2} \cdot Z_{\text{RHD}} \times e^{W/T}$ (R being the elements S, Se or Te). Z , the partition functions, have been calculated and, through experimental results, the constant W has been determined. Having obtained W , the equilibrium constant K has been calculated for a series of temperatures. (auth)

18888 DEGR-14(D)

United Kingdom Atomic Energy Authority. Development and Engineering Group, Dounreay, Caithness, Scotland. THE THERMAL PROPERTIES OF GASES FOR USE IN REACTOR HEAT-TRANSFER CALCULATIONS. G. V. Massey. 1960. 78p. BIS.

A revised standard set of values of the thermal conductivities, viscosities, and specific heats of hydrogen, helium, nitrogen, argon, krypton, xenon, carbon dioxide, and air over the temperature range 0 to 1000°C is presented for ease in heat-transfer calculations and experiments. Selected experimental values and an indication of the methods of calculation of the thermal conductivity and viscosity of some binary and ternary gas mixtures are also included. Attention was also given to the variation of these gaseous properties at pressures above atmospheric. A selection of published work, mainly since 1954, collected from a literature survey is reviewed and the values quoted are displayed in tabular and/or graphical form, from which standard graphs were derived. (auth)

18889 DEGR-148(CA)

United Kingdom Atomic Energy Authority. Development and Engineering Group, Capenhurst, Ches., England. THE DEPTH OF OXIDATION OF GRAPHITE. A THEORETICAL APPROACH. M. H. Dodson. Sept. 16, 1958. 17p. BIS.

For the reaction of graphite with oxygen, the depth of oxidation L is given theoretically by $L = (Z/k_v)^{0.5}$ where Z is the effective diffusion coefficient of oxygen through the gas in the pores of the graphite, and k_v is the rate constant expressed in terms of the volume of oxygen consumed. If L is very much less than the dimensions of a block of graphite, the rate of oxidation at a distance x from the surface is proportional to $\exp(-x/L)$. Similar results apply approximately to the reaction between carbon dioxide and graphite. The ratio of Z to the ordinary gaseous diffusion coefficient is of the order of 0.02 for grade A pile graphite. The depth of oxidation estimated from this figure is close to the experimental values obtained by Sheard et al. (auth)

18890 HW-62431

General Electric Co. Hanford Atomic Products Operation, Richland, Wash. THE PREPARATION OF URANIUM DIOXIDE FROM A MOLTEN SALT SOLUTION OF URANYL CHLORIDE. W. L. Lyon and E. E. Volland. Oct. 20, 1959. 16p. Contract AT(45-1)-1350. OTS.

Uranium oxides in a molten eutectic mixture of NaCl-KCl were chlorinated by bubbling chlorine gas through the mixture. The reaction product, uranyl chloride, was soluble in the molten salt. Although UO_2 was the most common oxide used, the reaction was similar in the other oxides. Phosgene and aluminum chloride were also used as chlorinating agents. A dense, crystalline precipitate of pure

UO_2 was prepared by the reduction of the uranyl chloride contained in the molten salt solution. The reduction was accomplished by contacting the salt solution with any of several metals. by reaction with hydrogen or dry ammonia gas. or by electrolysis. Several kilograms of UO_2 were prepared by electrolysis using graphite electrodes. The physical properties of the material made it potentially useful as a ceramic fuel material. The initial high particle density of the "as-produced" UO_2 was considered of great potential advantage for adapting this process to the refabrication of irradiated UO_2 into recycle fuel elements. (M.C.G.)

18891 IS-114

Ames Lab., Ames, Iowa.

TRANSPORT NUMBERS IN PURE FUSED ZINC CHLORIDE. Arnold Lundén. Apr. 1960. 33p. Contract W-7405-eng-82. OTS.

The transport numbers were measured for the cation and anion in molten zinc chloride using tracers. Due to non-ideal conditions, there was a pronounced tendency for the experiments to give too low values for t^+ and t^- . This tendency became stronger as the current density increased in the cell. An extrapolation to zero current gives $t^+ = 0.6 \pm 0.1$. There was no detectable temperature influence on the transport number in the region from 420°C to close to the boiling point, while measurements in the region below 420°C were uncertain due to the growth of dendrites of deposited zinc metal. No current transport by complex ions could be detected. (auth)

18892 NAA-SR-Memo-4417

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

LITERATURE SURVEY ON PROPERTIES OF SODIUM VAPOR. Guy Ervin, Jr. Sept. 25, 1959. 13p. OTS.

A literature survey was conducted to assess the adequacy of published data on the properties of sodium vapor and to obtain information to be used as a basis for recommending experimental work on further measurement of these properties. (J.R.D.)

18893 NAVORD-6741

Naval Ordnance Lab., White Oak, Md.

POLYCRYSTALLINE FERRIMAGNETIC GARNETS.

Elmer E. Anderson, J. Richard Cunningham, Jr., G. E. McDuffie, Jr., and W. E. Ayers. Nov. 17, 1959. 61p. (AD-231919).

Polycrystalline samples were prepared of yttrium-iron garnet and a number of rare earth garnets. The effect of ionic substitutions on such properties as lattice constants, magnetic moments, d-c conductivity, permittivity, and permeability is discussed. The magnetic properties of garnets are shown to be explained by the Néel theory using a 2- or 3-sublattice model. The permeability spectrum exhibited two absorption regions, one due to domain wall processes in the r-f region and the other due to spin resonance in the microwave region. Electrical losses are considered to be due to oxygen defects and the reduction of the ferric ion. (auth)

18894 NYO-7581

Pennsylvania State Univ., University Park.

FUSED SODIUM HYDROXIDE. Progress Report for period covered June 1, 1959 to May 31, 1960. Ralph P. Seward and Harry W. Otto. June 1960. 8p. Contract AT(30-1)-1881. OTS.

New equipment for measuring the rate of decomposition of perchlorate ion in fused NaOH is described. Evidence is presented to show that as the NaClO_4 starting concentration was increased the rate decreased. In the case of KClO_4 , as

the concentration is increased the rate increases. The results of preliminary experiments may indicate that the rate decreases with decreasing NaOH concentration. A large increase in the solubility of BaSO_4 in fused NaNO_3 is produced by the addition of NaOH. (auth)

18895 OOR-006-1

Little (Arthur D.) Inc., Cambridge, Mass.

STUDY OF HIGH-TEMPERATURE THERMODYNAMICS OF LIGHT-METAL COMPOUNDS. Interim Technical Report No. 1 [on] INFRARED SPECTRA OF GASEOUS GROUP IV HALIDES: ZIRCONIUM FLUORIDE, ZIRCONIUM CHLORIDE, AND HAFNIUM CHLORIDE. Alfred Büchler. Apr. 20, 1960. 10p. Contract DA-19-020-ORD-4829.

The infrared spectra of gaseous ZrF_4 , ZrCl_4 , and HfCl_4 were observed between 3000 and 200 cm^{-1} . The observed frequencies are: 668, 423, and 393 cm^{-1} respectively for ν_3 ; and ν_4 for ZrF_4 is 200 cm^{-1} . Results are reported of an experimental study of three gaseous Group IV halides. In a later note these results will be examined from the point of view of some of the force fields that have been proposed for the symmetric tetrahedral Group IV molecules. (auth)

18896 OOR-006-2

Little (Arthur D.) Inc., Cambridge, Mass.

STUDY OF HIGH-TEMPERATURE THERMODYNAMICS OF LIGHT-METAL COMPOUNDS. Interim Technical Report No. 2 [on] IONIC-MODEL CALCULATIONS: I. THE LITHIUM HALIDES. Alfred Büchler. Apr. 20, 1960. 11p. Contract DA-19-020-ORD-4829.

The effect of the introduction of the higher multipole polarizabilities of ions on ionic-model calculations was investigated. In the case of the lithium halides, the agreement between the observed and calculated vibration-rotation constants that is obtained when only dipole polarizabilities are used is destroyed when higher polarizabilities are introduced. The agreement between the observed and calculated dissociation energies is not affected. (auth)

18897 OOR-006-3

Little (Arthur D.) Inc., Cambridge, Mass.

STUDY OF HIGH-TEMPERATURE THERMODYNAMICS OF LIGHT-METAL COMPOUNDS. Interim Technical Report No. 3 [on] IONIC-MODEL CALCULATIONS: II. THE BENDING FORCE CONSTANTS OF THE GROUP II HALIDES. Alfred Büchler. Apr. 15, 1960. 19p. Contract DA-19-020-ORD-4829.

The bending force constants of the Group II halides were calculated for three versions of an ionic model of these molecules. The first version treats the ions as point charges; the second includes their dipole polarizabilities; the third is based on a multipole expansion that includes all terms up to the charge-(induced octupole) term. The calculations show that the ionic model cannot account for the observed magnitude of the bending force constants. (auth)

18898 TID-6124

Johns Hopkins Univ., Baltimore.

ABSORPTION AND FLUORESCENCE SPECTRA OF NdCl_3 AND STATES OF THE NEODYMIUM ION. Johns Hopkins Spectroscopic Report No. 18. E. H. Carlson. Mar. 1960. 139p. Contract AT(30-1)-1447. OTS.

The absorption and fluorescence spectra of crystals of NdCl_3 diluted with LaCl_3 are studied in the Zeeman effect at 4.2 and 77° . In addition to confirming levels of the ^4S , ^2P , ^2D , ^4D , ^4F , and ^2H terms of the $4f^3$ configuration of Nd^{3+} , levels of ^2G and ^4G are identified with absorption groups E through G and an additional ^4D level is found. Thus only the absorption group D and some levels far in the μ -v remain unidentified. The three lowest levels of

the ground term ^4I are found in the fluorescence band. The positions of the observed levels agree well with free ion levels calculated in intermediate coupling, and the observed Stark splittings agree with calculated splittings for some groups. Departures for other groups are not unexpected because intermediate coupling and J mixing are neglected. Most transitions obey electric dipole selection rules, and most of the others do not obey magnetic dipole selection rules. A new selection rule is observed to operate in the perpendicular Zeeman effect in that, for alternate values of J, the polarization reverses. (auth)

18899 TID-6167

Michigan. Univ., Ann Arbor.

THE GRAPHITE ELECTRODE: AN IMPROVED TECHNIQUE FOR VOLTAMMETRY AND CHRONOPOTENTIOMETRY. Report No. 57. Philip J. Elving and David L. Smith. June 20, 1960. 39p. Project 8. Contract AT(11-1)-70. OTS.

The application of the graphite electrode for voltammetry, which has been improved by wax impregnation of the electrode, by insulation, and by surface renewal by lathing, was further improved by prewetting of the electrode surface by a dilute solution of a wetting agent. The performance of the electrode, so prepared and conditioned, was evaluated for quantitative analysis by cathodic and anodic chronopotentiometric and voltammetric measurements in aqueous solution on the ferricyanide-ferrocyanide and quinone-hydroquinone systems, and on adenine, ascorbic acid, sulfanilamide, and tetraphenylborate. Chronopotentiometric transition time constants were constant to $\pm 3\%$ or better; a single calibration plot of $i\tau^{1/2}$ vs. concentration suffices for quantitative work. Comparable results are obtained by automatic recording voltammetry. The results compare favorably with those obtained with platinum electrodes. (auth)

18900 UCRL-8713(Rev.)

California. Univ., Berkeley. Lawrence Radiation Lab. FREE ENERGY FUNCTIONS FOR GASEOUS MONOXIDES. L. Brewer and M. S. Chandrasekharaiiah. June 1960. 17p. Contract W-7405-eng-48. OTS.

Free energy functions for gaseous monoxides were calculated from presently available spectroscopic results. However, the electronic contributions to the free energy functions were estimated. A simple ionic model was assumed since the molecular electronic states for most of these oxides were not known. In some instances where experimental data were insufficient to calculate the interatomic distances and the equilibrium frequencies of vibrations, they were estimated. The results of these calculations were tabulated for 500° intervals from room temperature up to 3000°K . (auth)

18901 WADD-TR-59-21

Rochester, N. Y. Univ.

AN INVESTIGATION OF THE PHYSICAL PROPERTIES OF MOLTEN BORON OXIDE AND BINARY ALKALI, ALKALINE EARTH AND RARE EARTH BORATES, WITH PARTICULAR EMPHASIS ON RUBIDIUM AND CESIUM BORATES. Gouq-Jen Su, Pei-Ching Li, and Anil C. Ghose. Apr. 1960. 121p. Project 3048. Contract AF33(616)-5698.

Results of a study of the physical properties of molten boron oxide and binary alkali, alkaline earth, and rare earth borates with special emphasis on rubidium and cesium borates are presented. Rubidium and cesium borates were found to exhibit the same type of boron anomaly as was reported by previous authors in case of other alkali borates. From the breaks, as observed in the case of vis-

cosity and density measurements, and substantiated in part by electrical resistivity and to a certain extent surface tension measurements, it was inferred that definite changes in structural configuration are taking place under those conditions. Density determinations of the rare earth borates point to the fact that neodymium and yttrium act as glass network formers. The rare earth oxides, so far studied, were found to lower the viscosity of the parent boron oxide glass at temperatures lower than 620°C. An inversion point was found at 620 to 670°C, above which all the rare earth oxides increase the viscosity of the base glass. (auth)

18902 Y-1298

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. AN INVESTIGATION OF A "DYNAMIC" THEORY FOR MASS TRANSFER. R. B. Schappel. May 13, 1960. 126p. Contract W-7405-eng-26. OTS.

A theory is proposed, the use of which would permit computation of individual "dynamic" mass-transfer coefficients from physical data. The theory retains the concept of the existence of resistance films at an interface but asserts that the driving force across a film is measured in terms of the difference in concentration, or partial pressure, of the transferred substance in the flowing bulk fluid before and after adiabatic mixing and equilibrium separation from the bulk fluid flowing in the opposite direction. Mass-transfer data of reasonable accuracy were obtained from the literature for continuous countercurrent systems employing columns packed with one-half inch Raschig rings. The systems chosen for analysis were not complicated by chemical reaction. Through the application of dynamic theory, the original data were processed to derive corresponding individual dynamic mass-transfer coefficients. Through the use of dimensional analysis, the coefficients were found to correlate with certain physical properties which are listed. The results of the study indicate that useful information might be obtained with further investigations involving the application of this theory and the related techniques demonstrated. (auth)

18903 AEC-tr-4116

THERMODYNAMIC CONSTANTS OF WATER INSOLUBLE HALIDES, SULFIDES, OXIDES AND HYDRATES OF METALS. N. P. Zhuk. Translated by Lydia Venters (Argonne National Lab.) from *Zhur. Fiz. Khim.* **28**, 1523-7 (1954). 9p. JCL or LC.

The values of thermodynamic constants of water-insoluble electrolytes were calculated from the values of solubility products found in the literature. The values of standard isobaric-isothermic potentials of water-insoluble electrolytes (halides, sulfides, oxides, and most metal hydroxides) were calculated from values of standard isobaric-isothermic potentials of the decay ion of the electrolytes and from the solubility products. Using standard heats of formation and the standard entropies of elements contained in the electrolytes, the values of standard entropies of the electrolytes were calculated. Results of the calculations are presented in tables. (M.C.G.)

18904 AERE-Trans-850

PRECISION DISTILLATION COLUMNS. W. Kuhn. Translated by R. Todd (U.K.A.E.A. Atomic Energy Research Establishment) from *Chem.-Ingr.-Tech.* **29**, 6-16(1957). 28p.

A precision distillation column is described which consists of unpacked or packed parallel tubes. With such a column, the required operating conditions can be exactly maintained; the mode of operation is described and the results achieved with the apparatus are discussed. (auth)

18905 NP-tr-466

OXYGEN PRESSURE AND RANGE OF STABILITY OF

NON-STOICHIOMETRIC OXIDES OF URANIUM OF THE TYPE OF UO_2 AND U_4O_9 . Aurelio Burdese. Translated by L. Pirt (U.K.A.E.A. Atomic Energy Research Establishment) from *Gazz. chim. ital.* **89**, 718-31(1959). 22p. JCL.

The reduction equilibria of U oxides obtained from U_3O_8 were studied in atmospheres of CO-CO₂ at 700 to 900°C and H₂-H₂O at 400 to 600°C. Reduction isotherms were interpreted and checked by x-ray examinations. The oxygen pressures of the solid as functions of composition and temperature were determined. The heat of oxidation of UO_2 to U_4O_9 was also determined. (J.R.D.)

18906

REACTION OF UF_6 WITH AMMONIA. N. P. Galkin, B. N. Sudarikov, and V. A. Zaitsev. *Atomnaya Energ.* **8**, 530-4 (1960) June. (In Russian)

The reaction of uranium hexafluoride with ammonia at -50 to +200°C was studied. Composite equations for the reaction are suggested for the temperature range of -50 to -30°C, $6UF_6 + 8NH_3 \rightarrow 6UF_5 + 6NH_4F + N_2$; for 0 to 25°C, $4UF_6 + 8NH_3 \rightarrow 2UN_5 + 2NH_4UF_5 + 4NH_4F + N_2$; for 100 to 200°C, $3UF_6 + 8NH_3 \rightarrow 3NH_4UF + 3NH_4F + N_2$. The rate of reaction at -50 to +20°C was evaluated. The thermal effect of the reaction at -50 to 30°C fluctuates between 50.8 to 83.6 kcal/mole and at -40°C it coincides with the value calculated with the suggested equation. (tr-auth)

18907

THE REACTION OF CARBON WITH CARBON DIOXIDE AT HIGH PRESSURE. J. D. Blackwood and A. J. Ingeme (Commonwealth Scientific and Industrial Research Organization, Melbourne). *Australian J. Chem.* **13**, 194-209 (1960) May.

A study was made of the reactions of purified carbon with carbon dioxide at pressures up to 40 atm and in the temperature range 790 to 870°C. The effect of carbon monoxide was examined by adding varying proportions of this gas to the carbon dioxide supplied to the reactor bed. At high carbon dioxide and carbon monoxide partial pressures, the rate of formation of carbon monoxide is greater than would be expected from the mechanism proposed by Gadsby et al. (1948). A mechanism is proposed whereby the increased rate may be explained by additional steps involving the interaction of a carbon dioxide molecule with an adsorbed carbon monoxide to produce adsorbed oxygen: $CO_2 + (CO) \rightarrow 2CO + (O)$. A general rate equation was derived which includes this step and satisfies the experimental results. The reverse mechanism by which carbon monoxide can disappear is not the simple reverse of the forward process and at high pressures equilibrium cannot be expressed by the usual expression derived for the simple single-stage reversible process. The possible nature of active sites was examined by studying the reactivity of a series of chars prepared at different temperatures. The reactivity appears to be related to the oxygen content of the chars and the type of active centers involved may be different from those which control the carbon-steam mechanism. (auth)

18908

INVESTIGATION OF $Ti(SO_4)_2-H_2SO_4-NaOH$ SYSTEM (20 AND 25°) BY SOLUBILITY METHODS AND THE METHOD OF APPARENT VOLUME OF PRECIPITATE. A. I. Ul'yanov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk* No. 4, 580-7(1960) Apr. (In Russian)

Simultaneous use of solubility and visual volume precipitation methods in one vessel is suggested. The process of radical formation in dilute solutions of $Ti(SO_4)_2-$

H_2SO_4 – NaOH – H_2O proceeds through three stages, with an increase of alkali: co-precipitation of H_2SO_4 with H_2TiO_2 , neutralization in the H_2SO_4 by NaOH up to the formation of H_2TiO_3 , and the co-precipitation of NaOH with H_2TiO_3 . The pH of the co-precipitation in reality corresponds to the precipitate pH of basic or bisalts of the elements. (R.V.J.)

18909

ANION EXCHANGE STUDIES. XXXI. ADSORPTION OF Zn(II) AND Ga(III) FROM HCl SOLUTIONS IN THE TEMPERATURE RANGE 25 to 150°. Kurt A. Kraus and Richard J. Raridon (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **82**, 3271–6(1960) July 5.

Adsorption functions of Zn(II) and Ga(III) were determined by the preloaded column technique in the temperature range 25 to 150° in HCl solutions. Large changes in adsorbabilities with temperature were observed. Adsorbability of negatively charged complexes decreases rapidly with increasing temperature and for GaCl_4^- , ΔH for the ion exchange reactions is ~ -14 kcal. (extrapolated to $m_{\text{HCl}} = 0$). The shape of the adsorption functions changes rapidly with temperature. From these changes one can deduce that the degree of complexing of Zn(II) and Ga(III) increases rapidly with temperature at constant chloride concentration. Attempts were made to estimate the average heats of the complexing reactions. While these are largely of a qualitative nature, one may conclude that with increasing temperature stability constants change in a direction which increases the preponderance of neutral species or of species of low absolute charge. (auth)

18910

THERMAL DIFFUSION OF TERNARY MIXTURES. A. E. de Vries and M. F. Laranjeira (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). *J. Chem. Phys.* **32**, 1714–16(1960) June.

Experiments were performed on ternary mixtures, consisting of two isotopes and a nonisotopic compound. It is found that the influence of the third compound on the separation of the isotopes cannot always be foreseen, the hardness (R_T value) being of extreme importance. (auth)

18911

REDETERMINATION OF THE INTERMOLECULAR POTENTIAL FOR KRYPTON. Edward A. Mason (Univ. of Maryland, College Park). *J. Chem. Phys.* **32**, 1832–6(1960) June.

The intermolecular potential for krypton was redetermined from transport property data, including new experimental results on thermal diffusion and thermal conductivity. Both the Lennard-Jones and the exp-6 potential functions were used and reproduce the data about equally well. The parameter α of the exp-6 potential is not uniquely determined by the data, but a tentative selection of $\alpha = 13.5$ was made semiempirically on the basis of the theory of the dispersion energy and the consistency with the other rare-gas potentials. The most important conclusion is that there is a large discrepancy, not found for the other rare gases, between the present results and the experimental crystal properties and second virial coefficient. No amount of parameter adjustment has been able to reduce the discrepancy to a reasonably acceptable value. Possible explanations and implications of this unusual and unsatisfactory situation are discussed. (auth)

18912

THEORY OF FUSED SALTS. Frank H. Stillinger, Jr., John G. Kirkwood, and Peter J. Wojtowicz (Yale Univ., New Haven). *J. Chem. Phys.* **32**, 1837–45(1960) June.

The properties of ionic pair distributions are investi-

gated for a simple fused-salt model. The short-range ion core forces are assumed to be identical for both anions and cations and, although the method is capable of handling mixtures of ions with different charges, only a single fused salt of the symmetrical-valence type is considered. A set of relations is developed to describe the asymptotic behavior (for large ion distances) of the ion pair distribution functions. These relations are obtained with benefit only of certain weak, plausible assumptions concerning the triplet superposition defects; as a consequence, the usual superposition approximation of liquid theory is circumvented. A significant feature of the results is prediction of concentric shells of average charge density surrounding a given ion in a manner suggesting local latticelike structure. (auth)

18913

ISOTOPE EFFECTS ON REACTION RATES AND THE REACTION COORDINATE. Max Wolfsberg (Oxford Univ.). *J. Chem. Phys.* **33**, 21–2(1960) July.

The high temperature limit of the reaction rate isotope effect is discussed. The Slater approach is compared in this respect to the transition state theory approach. There is no essential disagreement between the two approaches. The Slater assumption with respect to this limit for simple bond rupture represents a special case, however, and is not necessarily correct. (auth)

18914

FLOW ADAPTATION OF THE ISOTOPIC DILUTION METHOD FOR THE STUDY OF IONIC HYDRATION. H. W. Baldwin and H. Taube (Univ. of Chicago). *J. Chem. Phys.* **33**, 206–10(1960) July.

A method was developed for rapid mixing and sampling in the application of the isotopic dilution technique to the study of ionic hydration. The behavior of solutions of various salts was compared with that of solutions containing a hydrated cation of known formula, $\text{Cr}(\text{H}_2\text{O})_6^{3+}$. The holdback of water per ion of Al^{3+} is the same (within 0.4 molecules of H_2O) as that of Cr^{3+} , and $t_{1/2}$ for the exchange of $\text{Al}(\text{H}_2\text{O})_6^{3+}$ with H_2O is >0.02 sec. at 25°. For the exchange of water between $\text{Ni}^{2+}(\text{aq})$ or $\text{Fe}^{3+}(\text{aq})$ and solvent $t_{1/2}$ is less than 0.02 sec. (auth)

18915

ON THE EXISTENCE OF POLYOXIDES OF HYDROGEN. Sidney W. Benson (Univ. of Southern California, Los Angeles). *J. Chem. Phys.* **33**, 306–7(1960) July.

The existence of polyoxides of hydrogen was considered. Thermodynamic and kinetic evidence indicated that H_2O_4 cannot exist, while H_2O_3 , which might exist below 0°C, cannot be prepared by any method yet considered. (M.C.G.)

18916

CALCULATION OF EQUILIBRIUM CONSTANTS FOR SEVERAL ISOTOPE EXCHANGE REACTIONS INVOLVING N_2O_4 . E. U. Monse (Rutgers Univ., Newark, N. J.). *J. Chem. Phys.* **33**, 312–14(1960) July.

Calculations of partition function ratios of isotopic N_2O_4 molecules were made. Equilibrium constants for nitrogen and oxygen isotope exchange reactions among N_2O_4 , NO_2 , and NO were tabulated for different temperatures. The fundamental frequencies for the planar vibration of the isotopic molecules $\text{N}_2^{16}\text{O}_4^{16}$ and $\text{N}_2^{14}\text{O}_4^{16}$ were obtained from F and G matrices. The observed and calculated frequencies of NO_2 and N_2O_4 were listed. (M.C.G.)

18917

THE OSMOTIC BEHAVIOUR OF REPRESENTATIVE AQUEOUS SALT SOLUTIONS AT 100°. C. Stuart Patterson, L. O. Gilpatrick, and B. A. Soldano (Oak Ridge National Lab., Tenn.). *J. Chem. Soc.* 2730–34(1960) June.

Experimental osmotic coefficients for representative aqueous salt solutions at 99.6°C are presented as a function of concentration. The results are shown to be consistent with established concepts of electrolyte solutions. (auth)

18918

SOLUBILITIES OF Cs_2UCl_6 , $\text{Cs}_2\text{UO}_2\text{Cl}_4$, AND Cs_2PuCl_6 IN HYDROCHLORIC ACID. J. Kooi, E. Weisskopf, and D. M. Gruen (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem. **13**, 310-12(1960) May.

The solubilities of Cs_2UCl_6 , $\text{Cs}_2\text{UO}_2\text{Cl}_4$, and Cs_2PuCl_6 have been determined at concentrations of 1 to 12 M HCl. The possible use of Cs_2UCl_6 and Cs_2PuCl_6 as starting materials in the preparation of U and Pu metals is mentioned. (auth)

18919

REACTIONS OF IODINE IN LIQUID AMMONIA. G. W. Watt and D. R. Foerster (Univ. of Texas, Austin). J. Inorg. & Nuclear Chem. **13**, 313-17(1960) May.

The products of the interaction of iodine and liquid ammonia at -75°C are NH_4I and $\text{NI}_3 \cdot 12\text{NH}_3$; at -33.5°C a (probably) less highly ammoniated NI_3 is the stable solid phase, while at 25°C iodine oxidizes ammonia to elemental nitrogen. The reactions between NI_3 and liquid ammonia solutions of potassium amide and potassium at -33.5°C were shown to yield KI, N_2 , and NH_3 , and KI and N_2 , respectively. These studies lead to the conclusion that the products of the interaction of iodine and liquid ammonia at -75 to 25°C do not include any simple ionic I^{n+} species. (auth)

18920

THE EFFECT OF DISSOLVED AIR ON THE REDUCTION OF TRACER LEVEL PLUTONIUM-IV BY URANIUM-IV. E. N. Jenkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. **13**, 323-5(1960) May.

Rydberg has shown that 0.05 M solutions of uranous salts will remove $95 \pm 3\%$ of tracer level Pu from a solution of Pu(VI) and Pu(IV), in the absence of dissolved air. In the presence of air, $70 \pm 10\%$ was removed. A method is presented which shows that dissolved oxygen in the presence of excess U(IV) causes a partial re-oxidation of Pu(III) to Pu(IV). It was found that the re-oxidation of Pu(III) increased as the acidity of the solution decreased. (B.O.G.)

18921

CALORIMETRIC STUDIES OF THE KINETICS OF DISORDERING IN MgCd_3 AND Mg_3Cd . K. F. Sterrett, W. V. Johnston, R. S. Craig, and W. E. Wallace (Univ. of Pittsburgh). J. Phys. Chem. **64**, 705-9(1960) June.

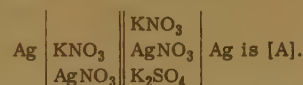
Measurements of the net disordering rates of MgCd_3 and Mg_3Cd samples slightly displaced from equilibrium were carried out using conventional adiabatic specific heat calorimetry. First order rate constants were measured between 217 and 312°K for MgCd_3 and between 316 and 334°K for Mg_3Cd . Regions appeared in which the rate constants diminished with increasing temperature. The interpretation of this behavior is discussed in terms of the Bragg-Williams theory. (auth)

18922

THE THERMODYNAMICS OF THE MOLTEN SALT SYSTEM KNO_3 - AgNO_3 - K_2SO_4 FROM ELECTROMOTIVE FORCE MEASUREMENTS. W. J. Watt and M. Blander (Oak Ridge National Lab., Tenn.). J. Phys. Chem. **64**, 729-32(1960) June.

Measurements of the activities of AgNO_3 were made in a molten salt concentration cell [A] at 363, 408, 438, and

449°C for dilute solutions of Ag^+ and SO_4^{2-} ions ($N_{\text{SO}_4^{2-}}$ and $N_{\text{Ag}^+} < 0.01$), where



The small negative deviations from ideality which were observed can be attributed to the negative energy of interaction of Ag^+ and SO_4^{2-} ions. Within the experimental precision of about 0.5 mv., $\log \gamma_{\text{AgNO}_3}$ is a linear function of $N_{\text{SO}_4^{2-}}$, and for a given concentration of SO_4^{2-} ions did not vary measurably with N_{Ag^+} . Although the lattice theory previously proposed strictly applies to mixtures with the cations and the anions, respectively, of the same size and charge, the data are consistent with the form of the equation derived from this theory. For dilute solutions and for small values of β , $\log \gamma_{\text{AgNO}_3} = -Z N_{\text{SO}_4^{2-}} (\beta - 1) / [2.303(1 + Z N_{\text{Ag}^+} \beta) (1 + Z N_{\text{Ag}^+})]$ where Z is the quasi-lattice coordination number, $\beta = e^{-\Delta E/RT}$, and ΔE is the energy of formation of the ion pair $\text{Ag}^+ - \text{SO}_4^{2-}$. The comparison of the data and equation leads to a value for $Z = 6$ of $\beta = 3.0$ and $\Delta E = 1.48$ kcal/mole at 408°C. (auth)

18923

DIFFUSION AND SEDIMENTATION OF ELECTROLYTES AND NON-ELECTROLYTES IN MULTICOMPONENT SYSTEMS. Hansjürgen Schöner (Boston Univ.). J. Phys. Chem. **64**, 733-7(1960) June.

The relationship between diffusion coefficients and sedimentation coefficients for any solute species in a multicomponent system containing electrolytes and/or non-electrolytes is derived by the methods of thermodynamics of irreversible processes. For a two component system the relationship reduces to the familiar Svedberg equation. In a case where two electrolytic components have one ion in common, the general equation is such that determinations of diffusion and sedimentation coefficients may be used to identify the kind and nature of the dissociation products. (auth)

18924

THE EQUILIBRIUM $\frac{2}{3}\text{Bi}(l) + \frac{1}{3}\text{BiCl}_3(g) = \text{BiCl}(g)$ AND THE THERMODYNAMIC PROPERTIES OF BiCl GAS. Daniel Cubicciotti (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Chem. **64**, 791-4(1960) June.

The reaction $\frac{2}{3}\text{Bi}(l) + \frac{1}{3}\text{BiCl}_3(g) = \text{BiCl}(g)$ was investigated by a transpiration technique in the range 600 to 700°C. The stoichiometry of the reaction was checked both by varying the activity of the gaseous reactants and by comparing the measured entropy (18 e.u.) with a calculated value. The enthalpy change for the reaction was found to be 24 kcal., which led to a value of 7 kcal. per mole for the enthalpy of formation of BiCl , gas, at 25°C. (auth)

18925

THE SOLUBILITY OF SILVER SULFATE IN ELECTROLYTE SOLUTIONS. PART 7. SOLUBILITY IN URANYL SULFATE SOLUTIONS. M. H. Lietzke and R. W. Stoughton (Oak Ridge National Lab., Tenn.). J. Phys. Chem. **64**, 816-20(1960) June.

The solubility of Ag_2SO_4 was measured in 0.100 to 1.348 m UO_2SO_4 solutions as a function of temperature to about 200°C. The agreement between calculated and observed solubilities was good when hydrolytic and complexing reactions of the uranyl ion were taken into account. The calculated concentrations of all assumed species are presented as functions of UO_2SO_4 concentration and temperature, and it is concluded that the relative stability of the neutral species UO_2SO_4 compared to UO_2^{2+} and $\text{UO}_2(\text{SO}_4)_2^{2-}$

increases with temperature. Both the enthalpy and entropy for the association of UO_2^{2+} and SO_4^{2-} into the neutral species appear to attain large positive values at elevated temperatures, indicating that a large degradation of solution structure occurs as the ions associate. (auth)

18926

PHASE RELATIONS IN THE SYSTEMS CsF-LiF , CsF-NaF AND $\text{CaF}_2\text{-LiF}$. Daniel L. Deadmore and James S. Machin (Illinois State Geological Survey, Urbana, Ill.). *J. Phys. Chem.* **64**, 824-5(1960) June.

The phase relations in the systems CsF-LiF , CsF-NaF , and $\text{CaF}_2\text{-LiF}$ were derived from cooling curves with the limit of error being about $\pm 5^\circ\text{C}$. Phase diagrams are given for CsF-NaF and $\text{CaF}_2\text{-LiF}$; no diagram is given for CsF-LiF because the data agree well with those of Thoma. The $\text{CaF}_2\text{-LiF}$ system is discussed as a model for the MgO-ThO_2 system. (D.L.C.)

18927

THE VAPOR PRESSURES OF LIQUID Bi-BiCl_3 SOLUTIONS. F. J. Keneshea, Jr., W. Wilson, and Daniel Cubicciotti (Stanford Research Inst., Menlo Park, Calif.). *J. Phys. Chem.* **64**, 827-9(1960) June.

The vapor pressures of pure BiCl_3 and of Bi-BiCl_3 mixtures were redetermined with the quasi-static and spiral gage methods and compared with data by the transpiration method. The agreement is within experimental error. (D.L.C.)

18928

THE HEAT OF FUSION OF BISMUTH TRICHLORIDE. A COMPARISON OF CALORIMETRIC AND CRYOSCOPIC DETERMINATIONS. L. E. Topol, S. W. Mayer, and L. D. Ransom (Atomics International, Canoga Park, Calif.). *J. Phys. Chem.* **64**, 862-5(1960) July.

The heat of fusion of BiCl_3 was determined to be 5.68 ± 0.08 kcal/mole with a drop calorimeter. With sodium, potassium and barium bromides and sodium iodide as solutes and the assumption of complete ionization, cryoscopic measurements yielded heats of fusion approaching this value at high dilutions, e.g., 4.72 kcal with solute concentrations less than 4.1 mole % and 5.48 kcal with concentrations under 1.5 mole %. With sodium and potassium chlorides as solutes much poorer agreement with the calorimetric value was found. The discrepancy in results probably is due to strong interactions among the ions, the interactions between BiCl_3 and the alkali chlorides being somewhat greater than those between BiCl_3 and the bromides. A phase equilibrium study of the KCl-BiCl_3 system showed a glassy region and two solid phases, K_3BiCl_6 and K_2BiCl_5 . The possibility of complex and polymer formation in the melt is considered. (auth)

18929

PHASE EQUILIBRIA IN THE SYSTEMS $\text{BeF}_2\text{-ThF}_4$ AND $\text{LiF-BeF}_2\text{-ThF}_4$. R. E. Thoma, H. Insley, H. A. Friedman, and C. F. Weaver (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **64**, 865-70(1960) July.

As a part of a study of materials potentially useful as fluid fuels of high temperature nuclear reactors, equilibrium diagrams for the condensed systems $\text{BeF}_2\text{-ThF}_4$ and $\text{LiF-BeF}_2\text{-ThF}_4$ were determined. Both thermal analysis and quenching techniques were used with phase identification accomplished by petrographic and x-ray diffraction analysis. The system $\text{BeF}_2\text{-ThF}_4$ contains a single eutectic at 2.0 ThF_4 (mole %), melting point $527 \pm 3^\circ$. In association with primary phase fields of the three components and five binary compounds, there occur six ternary invariant points within the system $\text{LiF-BeF}_2\text{-ThF}_4$. Of

these, only one invariant point is a eutectic. Unusual solid miscibility occurs in the compound 3 $\text{LiF} \cdot \text{ThF}_4$ which appears as a single phase solid solution within the area bounded by 75 LiF , 25 ThF_4 -58 LiF , 16 BeF_2 , 26 ThF_4 -59 LiF , 20 BeF_2 , 21 ThF_4 (mole %). (auth)

18930

SELF-DIFFUSION IN MOLTEN NITRATES. A. S. Dworkin, R. B. Escue, and E. R. Van Artsdalen (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **64**, 872-6(1960) July.

The self-diffusion coefficients D for the ions in molten LiNO_3 , NaNO_3 , KNO_3 , CsNO_3 , and AgNO_3 were measured as a function of temperature by the capillary method. The results are expressed in the form of the equation $D = A \exp(-\Delta H^\ddagger/RT)$. The values for the energy of activation for diffusion, ΔH^\ddagger , for the cation and anion, respectively, in kcal are: LiNO_3 , 5.49 and 6.34; NaNO_3 , 4.97 and 5.08; KNO_3 , 5.53 and 5.76; CsNO_3 , 5.61 and 6.28; and AgNO_3 , 3.73 and 3.84. The values for the diffusion coefficients, ($D \times 10^5$), for the cation and anion, respectively, in $\text{cm}^2 \text{sec}^{-1}$ at 350° are: LiNO_3 , (2.93) and (1.15); NaNO_3 , 2.33 and 1.48; KNO_3 , 1.52 and 1.35; CsNO_3 , (1.22) and (1.11); and AgNO_3 , (2.40) and (1.40). The results indicate that the diffusion coefficients of the cation vary inversely with ion size. The Nernst-Einstein relationship is shown not to hold for molten nitrates. Values for phenomenological friction coefficients as proposed by Laity are all positive and all but those for LiNO_3 are of the same order of magnitude. The friction coefficients for the relative motion of anion and cation and for cation and cation increase with increasing cation size while those for anion-anion motion decrease with increasing cation size. (auth)

18931

ANALYSIS OF ABSORPTION SPECTRA OF MULTICOMPONENT SYSTEMS. Richard M. Wallace (E. I. du Pont de Nemours & Co., Alken, S. C.). *J. Phys. Chem.* **64**, 899-901(1960) July.

A method was developed to find the number of components that contribute to the absorption spectrum of a multicomponent system. A complementary procedure was also developed to test for the presence of a non-absorbing species. The only assumption involved is that Beer's law is valid for each component. (auth)

18932

THE HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS OF URANIUM FROM 5 TO 350°K . Howard E. Flotow and Harold R. Lohr (Argonne National Lab., Ill.). *J. Phys. Chem.* **64**, 904-6(1960) July.

The heat capacity of uranium metal containing less than 0.01% impurities was measured from 5 to 350°K . From these data the entropy, enthalpy, and free energy function were calculated. The values of C_p , S° , $(H^\circ - H_0^\circ)$ and $(F^\circ - H_0^\circ)/T$ at 298.15°K are 6.612 ± 0.013 cal. deg. $^{-1}$ mole $^{-1}$, 12.00 ± 0.02 cal. deg. $^{-1}$ mole $^{-1}$, 1521 ± 3 cal. mole $^{-1}$ and -6.893 ± 0.014 cal. deg. $^{-1}$ mole $^{-1}$, respectively. The results are compared with previously published data. (auth)

18933

THE MERCURY-MERCURIC CHLORIDE SYSTEM. S. J. Yosim and S. W. Mayer (Atomics International, Canoga Park, Calif.). *J. Phys. Chem.* **64**, 909-11(1960) July.

A phase equilibrium study of the mercury-mercuric chloride system was carried out by thermal analysis and by the visual method. The salt-rich eutectic composition is 4.9 mole % Hg and occurs at 273° . The syntectic line at 525° extends from 48 to 94 mole % Hg . The solubility of HgCl_2 in Hg increases to 6.8 mole % at 560° . Freezing point depression measurements for HgCl_2 suggest that Hg

dissolves either as atoms or as Hg_2Cl_2 molecules formed by reaction of Hg with HgCl_2 . A thermodynamic analysis of the liquid-solid equilibrium curve between the salt-rich eutectic and the base of the miscibility gap suggests that solution of Hg as atoms is not likely in this region. (auth)

18934

HIGH-TEMPERATURE FREE ENERGY, ENTROPY, ENTHALPY AND HEAT CAPACITY OF THORIUM SULFATE. S. W. Mayer, B. B. Owens, T. H. Rutherford, and R. B. Serrins (Atomics International, Canoga Park, Calif.). *J. Phys. Chem.* **64**, 911-14(1960) July.

Decomposition pressures of $\text{Th}(\text{SO}_4)_2$ were measured from 908 to 1057°K. The results show that the decomposition reaction is: $\text{Th}(\text{SO}_4)_2(\text{s}) = \text{ThO}_2(\text{s}) + 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$. The heat capacity of $\text{Th}(\text{SO}_4)_2$ was determined from 623 to 897°K by a drop calorimeter technique and the results are given by: $C_p = 25.0 + 55.2 \times 10^{-3}T$ cal. mole⁻¹ deg.⁻¹. Least squares treatments of the decomposition pressure and heat capacity data were used to obtain equations for the thermodynamic functions of the decomposition reaction. Equations were calculated for the absolute entropy of $\text{Th}(\text{SO}_4)_2$ and for the standard free energy and enthalpy of formation of $\text{Th}(\text{SO}_4)_2$ from its elements. (auth)

18935

THE HEAT CONTENT OF BORON AT HIGH TEMPERATURES. Stephen S. Wise and John L. Margrave (Univ. of Wisconsin, Madison) and Robert L. Altman (Univ. of California, Berkeley). *J. Phys. Chem.* **64**, 915-17(1960) July.

The heat contents of commercially available "crystalline" and "amorphous" borons were measured from 500 to 1200°K. in a copper block-type drop calorimeter. Equations were derived for both forms, and heat capacities, free-energy functions and entropies were calculated. A Debye-Einstein heat capacity equation was derived for both amorphous and crystalline boron and used for calculation of thermodynamic functions over the range 0 to 2400°K. (auth)

18936

THE VOLATILITY OF ACTINIUM. K. W. Foster and L. G. Fauble (Monsanto Chemical Co., Miamisburg, Ohio). *J. Phys. Chem.* **64**, 958-60(1960) July.

Several 5 to 10 mg samples of Ac^{227} were prepared from purified salts by lithium reduction of actinium fluoride and volatilization of the actinium. Sufficient data were accumulated to permit calculation of an approximate value of the vapor pressure of the element at volatilization temperature. The actinium was volatilized at 1600° and the arithmetic mean of the vapor pressure values for six runs was 0.006 mm. The boiling point was calculated to be 3200° with an estimated error of $\pm 300^\circ$. (M.C.G.)

18937

ANALYSIS OF SOLUBILITY DATA TO ESTIMATE SMALL AMOUNTS OF CHAIN FRACTURE DURING THE CROSSLINKING OF RUBBER. L. Mullins and D. T. Turner (British Rubber Producers' Research Assn., Welwyn Garden City, Eng.). *Nature* **187**, 145-6(1960) July 9.

Procedures are discussed for the analysis of solubility data to estimate small amounts of chain fracture during the cross-linking of rubber by high-energy radiation. It is concluded that in order to estimate small values from solubility measurements, it is important to obtain data after sufficiently high doses and also to consider whether the assumption of a random molecular weight distribution is justified in order that relationship may properly be applied. (C.H.)

18938

HYDROGEN AS A POWER REACTOR COOLANT. Douglas Bradley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nucleonics* **18**, No. 7, 84; 86; 88(1960) July.

Hydrogen, the best of acceptable reactor coolants for heat transfer, is discussed with respect to the problems that will come up in its application. Molecular diffusion of H_2 is small (<1 lb/day) compared with leakage through circuit defects observed for Calder Hall reactors (~200 lb/day); therefore, leakage must be reduced. Because of the H_2 loss, an on-site H_2 plant is essential; electrolytic production using off-peak reactor power could be used as an economic source of H_2 . Explosion and detonation of H_2 -air mixtures are discussed; because autoignition occurs above 400°C, explosive air concentrations in the reactor must be avoided. This can be done by keeping the H_2 pressure above atmospheric pressure. An economic analysis of H_2 and CO_2 as coolants is made by comparing their pumping power needs at various temperatures and by evaluating the effects of blower power consumption on output. Finally, material compatibility with H_2 is discussed and the need for further research is emphasized, especially on radiation effects. Physical embrittlement of steel by H_2 solubility can be avoided if cooling rates are kept low to permit H_2 release. (D.L.C.)

18939

MEASUREMENT OF THE DIFFUSION COEFFICIENT OF CAESIUM IN MONOCRYSTAL OF NaCl WITH THE INTEGRAL METHOD OF LONGITUDINAL SECTION. Wladyslaw Chomka (Politechnika Gdanska, Danzig). *Nukleonika* **5**, 173-80(1960). (In Polish)

The diffusion coefficient of cesium in monocrystal NaCl was measured with the integral method of longitudinal section using the radioactive isotope Cs^{137} . The results were compared with those received by M. Chemla with the taking off layers method and it was found that the integral method of longitudinal section as well as the taking off layers method may be successfully used in measurements of relatively great diffusion coefficients. (auth)

18940

A ZnS(Ag)-PARAFFIN DETECTOR FOR FAST NEUTRONS. Kazimierz Mikke, Leslaw Adamski, and Edward T. Józefowicz (Instytut Badań Jadrowych, Warsaw). *Nukleonika* **5**, 181-9(1960). (In Polish)

A simple method for obtaining a ZnS(Ag)-paraffin fast neutron detector was developed with optimal composition and thickness. Its efficiency for neutron detection and ability to discriminate against gamma radiation were determined. Some properties of other scintillators of similar type were investigated and compared. (auth)

18941

MASS-SPECTROMETRIC INVESTIGATION OF SODIUM CHLORIDE AND LITHIUM FLUORIDE BY MEANS OF DOUBLE DIFFUSION CHAMBER. P. A. Akishin, L. N. Gorokhov, and L. N. Sidorov. *Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim.* No. 6, 194-204 (1959). (In Russian)

A double diffusion chamber was used for decoding the mass spectra of complex vapor. The method is applied for determining the composition of vapors and the thermodynamics of sodium chloride and lithium fluoride. The ratios of component pressures in sodium chloride and lithium fluoride vapors were found. The heat of sublimation of monomer, dimer, and trimer of lithium fluoride (kcal/mole) was determined. The heat of dissociation (kcal/mole) of $\text{Na}_2\text{Cl}_2 \rightleftharpoons 2 \text{NaCl}$, $\text{Na}_3\text{Cl}_3 \rightleftharpoons \text{NaCl} + \text{Na}_2\text{Cl}_2$,

$\text{Li}_2\text{F}_2 \rightleftharpoons 2 \text{LiF}$; and $\text{Li}_3\text{F}_3 \rightleftharpoons \text{LiF} + \text{Li}_2\text{F}_2$ was measured. (R.V.J.)

18742

ELECTRON PARAMAGNETIC RESONANCE OF Ti^{3+} IN CORUNDUM. L. S. Kornienko and A. M. Prokhorov (Inst. of Nuclear Physics, Moscow State Univ.). *Zhur. Ekspitl. i Teoret. Fiz.* 38, 1651-2(1960) May. (In Russian)

Electron paramagnetic resonance of Ti^{3+} ions isomorphically introduced into corundum (Al_2O_3) crystal lattices was observed at the temperature of liquid helium. The concentration of titanium ions in each specimen was of the order of several hundredths of an atomic percent. The experiments were carried out in the wave range of ~ 3 cm. An unusual asymmetric electron paramagnetic resonance line with a sharp drop with increasing magnetic field was found in corundum $\theta = 0^\circ$. The values of g-factors determined by the maximum intensity line were $g_{\parallel} = 1.067 \pm 0.001$; $g_{\perp} \leq 0.1$. The g_{\perp} was studied in relation to position as θ was varied from 0 to 67° . (R.V.J.)

18743

SYNTHESIS OF TANTALUM AND NIOBIUM IODIDES BY REACTION OF TaCl_5 AND NbCl_5 WITH Al_2I_6 AND SiI_4 . L. A. Nisel'son and I. V. Petrusovich (Kalinin Moscow Inst. of Non-Ferrous Metals and Gold). *Zhur. Neorg. Khim.* 5, 249-54(1960) Feb. (In Russian)

Tantalum and niobium iodides are of interest, since they can be used in the preparation of the pure metals. The exchange of halide between Al_2I_6 and SiI_4 with TaCl_5 and NbCl_5 was investigated thermographically. It was found that the reaction with NbCl_5 takes place at a lower temperature and is accompanied with the evolution of more heat than the corresponding reaction with TaCl_5 . It was shown that TaI_5 and niobium iodide with a composition of $\text{NbI}_{4.5-4.8}$ can be easily synthesized by these halide exchange reactions. Aluminum iodide gives better results than SiI_4 . (TTT)

18744

BASIC CHLORIDES AND HYDROXIDES OF YTTRIUM AND LANTHANUM. N. V. Aksel'rud and V. B. Spivakovskii (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). *Zhur. Neorg. Khim.* 5, 327-39(1960) Feb. (In Russian)

A potentiometric method was used to establish the composition and activity product of the basic salts of Y and La. A NaOH solution was added to a rare earth salt solution to give partial precipitation. Measurements were carried out 40 and 166 days later. Studies were also made on freshly prepared precipitates. The studies show that $\text{La}(\text{OH})_2\text{Cl}$ is formed at first and is converted to a salt of the composition $\text{La}(\text{OH})_{2.5}\text{Cl}_{0.5}$ after 65 days. The negative log of the activity product was 15.36 for $\text{La}(\text{OH})_2\text{Cl}$ and 18.37 for $\text{La}(\text{OH})_{2.5}\text{Cl}_{0.5}$. In the corresponding heterogeneous yttrium system part of the freshly prepared precipitate has the composition $\text{Y}(\text{OH})_{1.75}\text{Cl}_{1.25}$ and the other part is $\text{Y}(\text{OH})_3$. The composition is $\text{Y}(\text{OH})_{2.5}\text{Cl}_{0.5}$ after 100 days aging. The negative log of the activity product was found to have a value of 14.61 to 15.91 for $\text{Y}(\text{OH})_{1.75}\text{Cl}_{1.25}$; 23.17 for $\text{Y}(\text{OH})_3$ and 22.46 for $\text{Y}(\text{OH})_{2.5}\text{Cl}_{0.5}$. (TTT)

18745

BASIC CHLORIDES AND HYDROXIDES OF SAMARIUM. N. V. Aksel'rud and V. B. Spivakovskii. *Zhur. Neorg. Khim.* 5, 340-7(1960) Feb. (In Russian)

The composition of the basic chlorides of Sm were determined by measuring three variables: the activity of Sm^{3+} was determined by calculation, that of chlorine ion by a AgCl electrode or at high concentrations by a calomel

electrode and that of hydroxyl ion by measurement with a glass electrode. The experiments were maintained at a temperature of 25°C . It was found that $\text{Sm}(\text{OH})_2\text{Cl}$ precipitates at first on the addition of caustic to a rare earth solution, and that this compound is converted to $\text{Sm}(\text{OH})_3$ on aging. The activity product of the basic chloride salt and of the samarium hydroxide depends on the activity of chloride in the solution. On aging $\text{Sm}(\text{OH})_3$ becomes more difficultly soluble, the activity product decreases and chloride ion has less effect on the activity product. (TTT)

18746

BASIC CHLORIDES AND HYDROXIDES OF DYSPROSIUM. N. V. Aksel'rud and V. B. Spivakovskii (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). *Zhur. Neorg. Khim.* 5, 348-55(1960) Feb. (In Russian)

In determining the composition and activity product of basic salts and hydroxides of various metals it is necessary to measure the activity of the metal and anion and the pH of the solution. The activity of the chloride ion can be readily measured with a AgCl electrode or a calomel electrode and the pH of the solution with a glass electrode. The activity of the metal can be calculated empirically if the activity coefficient of DyCl_3 is known for solutions containing NaCl. A plot of activity coefficients of various rare earth chlorides versus the ionic radius results in a series of continuous curves which can be used to estimate activity coefficients of specific rare earths for which the data is unavailable at present. The composition of freshly prepared dysprosium basic chloride corresponds to the formula $\text{Dy}(\text{OH})_{1.75}\text{Cl}_{1.25}$ which has an activity product equal to 1×10^{-15} . A small amount of $\text{Dy}(\text{OH})_{2.85}\text{Cl}_{0.15}$ is also coprecipitated. With an activity of chloride ion from 0.00 to 0.70 the basic salt is $\text{Dy}(\text{OH})_2\text{Cl}$. The activity product of $\text{Dy}(\text{OH})_2\text{Cl}$ decreases with a decrease in activity of chlorine ion in solution. Aging always resulted in conversion of the basic chloride salt to the hydroxyl compound whose activity product was found to be equal to 1.3×10^{-26} irrespective of the activity of chloride ion in solution. (TTT)

18747

THERMAL DECOMPOSITION OF RARE EARTH CARBONATES OF THE CERIUM SUB-GROUP. M. N. Ambrozhi, E. F. Luchnikova, and M. I. Sidorova (Chernyshevskii Saratov State Univ.). *Zhur. Neorg. Khim.* 5, 366-71(1960) Feb. (In Russian)

The thermal decomposition of $\text{La}_2(\text{CO}_3)_3 \cdot 8\text{H}_2\text{O}$, $\text{Ce}_2(\text{CO}_3)_3 \cdot 5\text{H}_2\text{O}$, $\text{Pr}_2(\text{CO}_3)_3 \cdot 8\text{H}_2\text{O}$, $\text{Nd}_2(\text{CO}_3)_3 \cdot 8\text{H}_2\text{O}$, and $\text{Sm}_2(\text{CO}_3)_3 \cdot 3\text{H}_2\text{O}$ proceeds in the following manner. First, water of crystallization is evolved at 100 to 200°C . In the second stage, compounds containing a variable amount of carbonate are formed with the exception of samarium carbonate which decomposes directly to samarium oxide. In the third stage the rare earth oxides are formed. The rare earth carbonates can be arranged in order of increasing thermal stability as follows: $\text{Pr}_2(\text{CO}_3)_3$ (570°C) < $\text{Ce}_2(\text{CO}_3)_3$ (570°C) < $\text{Sm}_2(\text{CO}_3)_3$ (650°C) < $\text{Nd}_2(\text{CO}_3)_3$ (670°C) < $\text{La}_2(\text{CO}_3)_3$ (830°C). The temperatures in parentheses are those at which complete conversion of the carbonate to the oxide takes place. (TTT)

18748

THE COMPOSITION AND PROPERTIES OF TRIVALENT CERIUM CARBONATES. Su Ch'ang and Shih I-I. (Inst. of Applied Chemistry, Academy of Sciences of Chinese National Republic, Changchun). *Zhur. Neorg. Khim.* 5, 372-80 (1960) Feb. (In Russian)

In the systems $\text{Me}_2\text{CO}_3 - \text{Ce}(\text{NO}_3)_3 - \text{H}_2\text{O}$, where $\text{Me} = \text{Li}^+$, Na^+ , K^+ , and NH_4^+ , cerium was precipitated as the carbon-

ate salt by adding varying amounts of the alkali carbonate to a 0.1 M $\text{Ce}(\text{NO}_3)_3$ solution. After filtering off the carbonate precipitate, the solution was analyzed for cerium by precipitation with oxalate, for carbonate by titration with HCl, and for pH potentiometrically. In addition, measurements were made on the apparent volume and electrical conductivity at definite ratios of carbonate to cerium in the mixture. It was found that in all cases trivalent cerium reacts with Me_2CO_3 to form a normal carbonate with the composition $\text{Ce}_2(\text{CO}_3)_3$ except that in the system Na_2CO_3 — $\text{Ce}(\text{NO}_3)_3$ — H_2O a complex compound with the composition $\text{Na}[\text{Ce}(\text{CO}_3)_2]$ is also formed. (TTT)

18949

QUATERNARY SYSTEM OF LITHIUM, SODIUM, POTASSIUM AND CALCIUM FLUORIDES. G. A. Bukhalova and V. T. Berezhnaya (Rostov-on-Don Construction Inst., USSR). *Zhur. Neorg. Khim.* **5**, 456-68(1960) Feb. (In Russian)

The fluorides of the alkali and alkaline earth metals have a higher temperature of fusion than the halides and are finding more extensive use in fused salt electrolysis of non-ferrous metals. Five regions of crystallization of CaF_2 , LiF , NaF , KF , and the complex $\text{K}(\text{CaF}_3)$ are defined for the system Li , Na , K , $\text{Ca}|\text{F}$. These regions converge at two, four-component non-variant points, one transition point (566°C) and a eutectic (444°C). The complex $\text{K}(\text{CaF}_3)$ within the four-component system has an incongruent character. (TTT)

18950

INVESTIGATION OF THE SYSTEM K_2SO_4 — Cs_2SO_4 — $\text{Al}_2(\text{SO}_4)_3$ — H_2O AT 50°C. L. A. Khripin and I. N. Lepeshkov (Ushinskii Yaroslav State Pedagogical Inst., USSR). *Zhur. Neorg. Khim.* **5**, 481-93(1960) Feb. (In Russian)

The aqueous, quaternary system of potassium, cesium, and aluminum sulfates is of interest in the purification of cesium salts. The solubility, density, and viscosity of the solutions, and the solid phases of the ternary systems K_2SO_4 — $\text{Al}_2(\text{SO}_4)_3$ — H_2O , Cs_2SO_4 — $\text{Al}_2(\text{SO}_4)_3$ — H_2O , and K_2SO_4 — Cs_2SO_4 — H_2O were investigated at 50°C. It was established that potassium sulfate does not form a solid solution with cesium sulfate. In the ternary systems $\text{Cs}_2\text{Al}_2(\text{SO}_4)_4$ — $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ — H_2O and $\text{Cs}_2\text{Al}_2(\text{SO}_4)_4$ — $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ — H_2O it was found that potassium alum does not form a solid solution with cesium alum, but that ammonium alum can form a solid solution with the cesium alum (with a maximum of 9.02% of ammonium alum). Cesium alum, potassium alum, cesium sulfate, and potassium sulfate are formed in the quaternary system K_2SO_4 — Cs_2SO_4 — $\text{Al}_2(\text{SO}_4)_3$ — H_2O at 50°C. Aluminum sulfate is very soluble in this system. The cesium and potassium alums do not form solid solutions. The ability of various alums to form solid solutions depends on the alkali metal. If the alkali sulfates do not form solid solutions, the corresponding alums will not form solid solutions. As the difference in ionic radii of the alkali metals increases, the tendency of the corresponding alums to form solid solutions decreases. It may be predicted that solid solutions of alums will be formed in the systems $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ — $\text{Rb}_2\text{Al}_2(\text{SO}_4)_4$ — H_2O , $\text{Cs}_2\text{Al}_2(\text{SO}_4)_4$ — $\text{Rb}_2\text{Al}_2(\text{SO}_4)_4$ — H_2O , and $\text{Rb}_2\text{Al}_2(\text{SO}_4)_4$ — $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ — H_2O , since the corresponding alkali sulfates form solid solutions. (TTT)

18951

MEASUREMENT OF THE SATURATED VAPOR PRESSURE OF CESIUM CHLORIDE WITH THE USE OF RADIOACTIVE TRACER Cs^{137} . A. N. Nesmeyanov and L. A. Sazonov. *Zhur. Neorg. Khim.* **5**, 519-21(1960) Mar. (In Russian)

The saturated vapor pressure of solid CsCl was measured from 605 to 851°K. The data can be expressed by the

equation: $\log p = -9620/T + 9.4458$, where p = vapor pressure in mm Hg and T = the temperature in degrees Kelvin. The transition $\alpha\text{CsCl} \rightarrow \beta\text{CsCl}$ at 725°C could not be observed. The heat of sublimation was calculated as $\Delta H_0^\circ = 49.54 \pm 0.47$ kcal/mol. A specific activity of 200 mc/g of CsCl salt does not result in sufficient radiation damage to the crystalline lattice to affect the values obtained for the saturation vapor pressure. (TTT)

18952

PREPARATION AND PROPERTIES OF CERIUM(IV) PERCHLORATE. A. A. Zinov'ev and N. A. Shchirova. *Zhur. Neorg. Khim.* **5**, 540-6(1960) Mar. (In Russian)

Cerium(IV) perchlorate is readily formed by reaction of cerium hydroxide with perchloric acid, but this process is complicated by hydrolysis and partial reduction of cerium(IV). In addition, a considerable amount of water of crystallization is retained by the perchlorate salt. Even with the use of the monohydrate of perchloric acid (84.4% perchloric acid) instead of the dihydrate (72.6% perchloric acid), a considerable amount of hydrolysis and reduction of cerium(IV) perchlorate takes place. The reaction of anhydrous perchloric acid with cerium hydroxide results in the formation of perchloroceric acids, the compositions of which are very complicated. The crystallization of these compounds is very sluggish. A study of the thermal decomposition of both basic and acid salts of cerium(IV) perchlorate shows that perchloric acid is split out and evolved gradually from the reaction mixture. At the same time, evolution of oxygen occurs with a yield of 18.5 to 21%. The decomposition of the basic salt is accompanied by a considerable absorption of heat which is attributed to the evolution of the dihydrate of perchloric acid (boiling point 203°C). No perchlorate could be detected in the residues which were analyzed after thermal decomposition. The total content of cerium in the residues varied from 71 to 75% of which 67 to 69% was Ce(IV) . 15 references. (TTT)

18953

BASIC CHLORIDE SALTS OF ERBIUM AND YTTERBIUM. N. V. Aksel'rud and V. B. Spivakovskii (Inst. of General and Inorganic Chemistry, Ukrainian, SSR). *Zhur. Neorg. Khim.* **5**, 547-57(1960) Mar. (In Russian)

The formation of basic salts is indicated by the fact that a rare earth salt can be completely precipitated by less than 3.0 equivalents of NaOH. To determine the composition and activity product of the insoluble basic salts, it was necessary to measure chloride activity with a silver chloride or calomel electrode and hydroxide activity by determining the pH of the solution with a glass electrode. Since there were no literature data on activity coefficients of ErCl_3 and YbCl_3 in aqueous solution, the activity values were derived from graphs relating known activity values of other rare earths to the ionic radii of the rare earth elements. Freshly precipitated basic salts of erbium and ytterbium have a composition corresponding to the formula $\text{M}(\text{OH})_2\text{Cl}$ with an activity product that depends on the activity of chlorine ion in solution. After aging for 50 days, the precipitate corresponds to the formulas $\text{Er}(\text{OH})_{2.5}\text{Cl}_{0.5}$ (activity product = 1.3×10^{-22}) and $\text{Yb}(\text{OH})_{2.5}\text{Cl}_{0.5}$ (activity product = 7.9×10^{-23}). The activity of chlorine ion had a smaller effect on the activity product of the aged precipitates. (TTT)

18954

SOLUBILITY AND THERMAL STABILITY OF ZIRCONIUM OXYCHLORIDE. L. N. Komissarova, V. E. Plyushchev, and I. N. Kremenskaya (Inst. of Fine Chemical Tech., Moscow). *Zhur. Neorg. Khim.* **5**, 586-92(1960) Mar. (In Russian)

Pure samples of $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$, hafnium free, were used to provide accurate data on solubility and thermal stability. It was established that the solubility of $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$ increases with increasing temperature and attains a maximum at 70.5°C (42 wt. % ZrO_2). The thermal analyses were carried out by heating samples in air to constant weight at different temperatures, and by continuously recording the loss in weight of a sample as it was heated. It was established that three molecules of water of crystallization are lost at 45 to 65°C , four molecules of water of crystallization and 0.3 molecule of Cl_2 at 65 to 150°C , and one molecule of water of crystallization and 0.7 molecule of Cl_2 at 150 to 400°C . After heating to 400 , 500 , and 600°C , the residues (ZrO_2) contained no chlorine and were practically insoluble in water. (TTT)

18955

MUTUAL SOLUBILITY OF LANTHANUM AND SODIUM SULFATES. V. B. Tulinova, V. E. Plyushchev, I. V. Ternovskaya, S. N. Lukova, and R. G. Samuseva (Lomonosov Moscow Inst. of Fine Chemical Tech.). *Zhur. Neorg. Khim.* **5**, 695-700(1960) Mar. (In Russian)

The solubility in the system $\text{La}_2(\text{SO}_4)_3 - \text{Na}_2\text{SO}_4 - \text{H}_2\text{O}$ was studied at 25 , 50 , and 75°C . The solubility of the sulfates decreases with an increase in temperature. With no sodium sulfate in the aqueous phase, the solubility of $\text{La}_2(\text{SO}_4)_3$ varies from 2.02 wt. % at 25°C to 0.99 wt. % at 75°C . With 2 to 4% wt. % Na_2SO_4 in the aqueous phase there is <0.001 wt. % La_2SO_4 in solution. It was found that $\text{La}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$ is the only double sulfate salt of lanthanum and sodium which crystallizes from solution in this system. Thermographic analysis shows that the salt $\text{La}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$ loses water at 355°C and decomposes into its sulfate components at 737°C . Interplanar distances are calculated for the double salt from x-ray data. The double-salt crystals are polyhedral, well formed, optically positive, and strongly doubly refractive with a direct extinction coefficient. The refractive indices are $n_g = 1.586 \pm 0.003$ and $n_p = 1.564 \pm 0.003$. (TTT)

18956

FORMATION OF CERIUM(III) HYDROXIDE. I. V. Tananaev and M. Ya. Bokmel'der (Moscow Engineering Physics Inst.). *Zhur. Neorg. Khim.* **5**, 701-7(1960) Mar. (In Russian)

It has been known that Ce(III) forms a basic salt, because the precipitation of cerium is complete before the theoretical amount of caustic is added to the rare earth salt solution, but the composition of the basic salt of cerium has not been accurately investigated. Changes in pH, electric conductivity, and apparent volume of the precipitate as well as changes in the composition of the liquid and solid phases were investigated on the addition of NaOH to a dilute (0.025 gram-ion/liter) chloride or sulfate solution of cerium(III). All experiments were carried out in freshly distilled water under an atmosphere of nitrogen to exclude carbon dioxide. Oxygen was removed from the nitrogen by bubbling through a pyrogallate solution to prevent the oxidation of cerous ion to ceric. It was found that in the system $\text{Ce}_2(\text{SO}_4)_3 - \text{NaOH} - \text{H}_2\text{O}$ an unstable basic salt $\text{Ce}_3(\text{OH})_5(\text{SO}_4)_2$ is formed which is transformed to the more stable salt $\text{Ce}_2(\text{OH})_4\text{SO}_4$ on further addition of caustic (at $n = 2$ where $n = \text{the ratio of } (\text{NaOH}) : (\text{Ce}^{3+}) \text{ in the starting mixture}$). At $n = 2.5$ the basic sulfate salt decomposes rapidly to cerous hydroxide which tenaciously retains a residual amount of sulfate that can not be removed even with a two-fold excess of caustic ($n = 6.0$). Cerium(III) chloride first forms the unstable basic salt $\text{Ce}_2(\text{OH})_5\text{Cl}$

which is converted to the hydroxide on further addition of caustic. Cerium(III) hydroxide does not adsorb excess caustic from solution. (TTT)

18957

SOLUBILITY ISOTHERMS OF THE SYSTEM $\text{UO}_2(\text{NO}_3)_2 - \text{Mg}(\text{NO}_3)_2 - \text{H}_2\text{O}$ at 0° AND 25°C . M. A. Yakimov and N. F. Nosova. *Zhur. Neorg. Khim.* **5**, 720-1(1960) Mar. (In Russian)

Data are presented on the solubility isotherms in the ternary system $\text{UO}_2(\text{NO}_3)_2 - \text{Mg}(\text{NO}_3)_2 - \text{H}_2\text{O}$. Uranium is separated from magnesium by solvent extraction with ether, back-extracted with water, precipitated with ammonium hydroxide, and weighed as UO_2 . Magnesium is precipitated with oxyquinolate as $\text{Mg}(\text{C}_9\text{H}_6\text{ON})_2 \cdot 4\text{H}_2\text{O}$. The results show that a eutectic is formed at 5.5 wt. % $\text{UO}_2(\text{NO}_3)_2$ and 37.2 wt. % $\text{Mg}(\text{NO}_3)_2$ at 0°C , and at 16.0 wt. % $\text{UO}_2(\text{NO}_3)_2$ and 37.0 wt. % $\text{Mg}(\text{NO}_3)_2$ at 25°C . No double salts could be detected under the conditions of these experiments. (TTT)

18958

SOLUBILITY PRODUCT OF PLUTONIUM(IV) DIPHOSPHATE AND ITS SOLUBILITY IN CERTAIN ACIDS. R. G. Denotkina, A. I. Moskvina, and V. B. Shevchenko. *Zhur. Neorg. Khim.* **5**, 805-10(1960) Apr. (In Russian)

The solubility of $\text{Pu}(\text{HPO}_4)_2 \cdot x\text{H}_2\text{O}$ was determined in HClO_4 and HNO_3 solutions at a constant ionic strength and variable acidity up to 2.0 N in hydrogen ion. Constant ionic strength was maintained by adding NaClO_4 or LiNO_3 . The solubility of $\text{Pu}(\text{HPO}_4)_2 \cdot x\text{H}_2\text{O}$ increases with increasing hydrogen ion concentration and is higher in the nitrate solutions because of the formation of the nitrate complex $\text{Pu}(\text{NO}_3)_3^{3+}$ with an instability constant of 2.9. A saturated aqueous solution of $\text{Pu}(\text{HPO}_4)_2 \cdot x\text{H}_2\text{O}$ has a pH = 3.55 to 3.60, which is caused by hydrolysis of Pu(IV) as follows: $[\text{Pu}(\text{HPO}_4)_2(\text{H}_2\text{O})_m] + \text{H}_2\text{O} \rightleftharpoons [\text{Pu}(\text{HPO}_4)_2(\text{H}_2\text{O})_{m-1}\text{OH}]^+ + \text{H}_3\text{O}^+ + (\text{HPO}_4)^{2-}$. From solubility data of $\text{Pu}(\text{HPO}_4)_2 \cdot x\text{H}_2\text{O}$ in water, $\text{NaClO}_4 - \text{HClO}_4$ mixtures, $\text{LiNO}_3 - \text{HNO}_3$ mixtures, and $\text{HNO}_3 - \text{H}_3\text{PO}_4$ mixtures, it was possible to calculate a solubility product by three different methods. The average value of the solubility product was found to be 2×10^{-28} . A comparison of the solubility product of Pu(IV) with those of Th and U shows that the plutonium diphosphate is the least soluble, as would be expected with the decrease in ionic radius in the series Th — Pu. (TTT)

18959

POLAROGRAPHY OF URANIUM IN CARBONATE AND BICARBONATE SOLUTIONS. REDUCTION WAVES OF URANYL CARBONATE COMPLEXES. A. I. Stabrovskii. *Zhur. Neorg. Khim.* **5**, 811-20(1960) Apr. (In Russian)

A solution with 9.13×10^{-4} mol/l of U(VI) in 0.05 mol/l of $(\text{NH}_4)_2\text{CO}_3$ showed only one reduction wave of U(VI) to U(V) . On increasing the carbonate concentration, a second reduction wave of U(V) to U(IV) was observed that is sharper at 0°C than at 25°C . With Na_2CO_3 only the first reduction wave of U(VI) to U(V) is observed, while with NaHCO_3 a second reduction wave of U(V) to U(IV) is also observed. The half-wave potential ($E^{1/2}$) for the U(VI) to U(V) reduction varied from -0.7 to -0.9V and for the U(V) to U(IV) reduction, from -1.3 to -1.4V . Thus, a decrease in temperature or pH of the solution and an increase in U(VI) , carbonate, and bicarbonate in solution favor the occurrence of a second reduction wave of U(V) to U(IV) . At higher concentrations of U(VI) in solution a maximum in the second reduction wave of U(V) to U(IV) is observed that is ascribed to the precipitation of UO_2 on the dropping mercury electrode. The saturation current of the U(VI) to U(V)

reduction increases with increasing carbonate or bicarbonate concentration, but the half-wave potential of this reaction decreases with increasing U(VI) concentration. U(IV) is not reduced on a dropping mercury electrode easily oxidized to U(VI) with a half-wave potential of +0.031 to +0.094 v with an average saturation current of 7.5 μ A/mm² at a pH of 7.22 to 8.92. In bicarbonate solutions a maximum occurs due to the reaction $[\text{U}(\text{OH})_2(\text{CO}_3)_2]^{4-} + \text{HCO}_3^- + \text{H}^+ \rightleftharpoons [\text{U}(\text{CO}_3)_3]^{6-} + 2\text{H}_2\text{O}$. On mixing equimolar quantities of U(VI) and U(IV) to form a solution containing 0.01 mol/l of total uranium, it was shown that predominantly U(V) is formed as a result of the following equilibrium: $\text{U(VI)} + \text{U(IV)} \rightleftharpoons \text{U(V)}$. The reduction of U(VI) and the oxidation of U(V) in carbonate solution go slowly with a substantial overvoltage and can be considered as practically irreversible. The data indicate that U(VI), U(V), and U(IV) carbonate complexes are subject to hydrolysis in carbonate-bicarbonate solutions. The hydrolyzed forms of U(V) and U(IV) carbonate complexes cannot be reduced readily on a dropping electrode but are easily oxidized. (TTT)

18960

ACID STABILITY AND METHODS OF ANALYSIS OF TITANIUM, ZIRCONIUM, NIOBIUM AND TANTALUM NITRIDES. O. I. Popova and G. T. Kabannik (Inst. of Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). *Zhur. Neorg. Khim.* **5**, 930-4(1960) Apr. (In Russian)

A 0.1 to 0.15 g sample of nitride was treated with 40 to 50 ml of solution for 24 hr in the cold and for 2 hr in the boiling solution. The sample was then centrifuged, dried, and weighed, and the content of metal in the solution was determined. The chemical stability can be represented in the order: $\text{Zr} < \text{Ti} < \text{Nb} < \text{Ta}$. Titanium nitride is stable in almost all acids except nitric acid. TiN dissolves almost completely in a mixture of $\text{HNO}_3 + \text{HF}$, 30% H_2O_2 , a mixture of $\text{H}_2\text{SO}_4 + \text{K}_2\text{SO}_4$, aqua regia, and nitric acid. In alkaline solutions TiN dissolves partially with formation of a hydrous precipitate. ZrN is insoluble in the cold in HCl (1:1) and HClO_4 (1:3), but on boiling, 85% dissolves in HCl (1:1), 31% in HNO_3 (1:1), and 100% in concentrated H_2SO_4 . ZrN is insoluble in boiling 30% H_2O_2 . Niobium nitride is not dissolved in the cold in various acids but dissolves completely in concentrated H_2SO_4 and a mixture of $\text{HNO}_3 + \text{HF}$ (1:1) on boiling. NbN dissolves completely in a boiling mixture of NaOH (10 and 40%) and H_2O_2 . Tantalum nitride dissolves completely only in a mixture of $\text{HNO}_3 + \text{HF}$ or $\text{H}_2\text{SO}_4 + \text{K}_2\text{SO}_4$ (10 ml + 10 g). On boiling in 10% NaOH + H_2O_2 , it was found that 61% of the TaN had dissolved. Samples (0.1 g) of ZrN, TiN, NbN, and TaN were fired in a muffle furnace at 1000°C to constant weight of the corresponding oxide. Corresponding nitride samples were dissolved either in concentrated H_2SO_4 (ZrN and NbN) or in $\text{HNO}_3 + \text{HF}$ (TiN and TaN). Firing of the metal cupferrates precipitated from the diluted solutions gave results in agreement with those obtained by firing the nitrides directly to the oxides. Nitrogen determinations by the Kjeldahl method on the nitride samples gave consistent results, if the sample was first dissolved in concentrated H_2SO_4 (ZrN and NbN) or in concentrated $\text{H}_2\text{SO}_4 + \text{K}_2\text{SO}_4$ (10 ml + 5 to 7 g). (TTT)

18961

INTERACTION BETWEEN URANIUM TRIOXIDE AND SOLID CARBON. V. G. Vlasov and V. A. Kozlov. *Zhur. Priklad. Khim.* **33**, 760-5(1960) Apr. (In Russian)

The direct reduction of in vacuum of UO_3 with C takes place at the relatively low temperatures of 350 to 400°C with charcoal and at 450 to 530°C when carbon obtained from sugar is used. Previous observations of W. Biltz

and H. Müller (Z. anorg. u. allg. Ch. **163**, 245, 279 (1927)) that dissociation occurs at temperatures above 430°C were confirmed and therefore such a dissociation cannot be stipulated as a preliminary phase of the direct reduction process. Diffusion of the C across the solid layer appears to be improbable because this oxide does not form carbide easily. Most probably, the reduction performed by the carbon oxide formed according to the reaction $\text{C} + \text{CO}_2 = 2\text{CO}$. The activation energy of the reduction by means of charcoal is 43 kcal/mol and by C from sugar 65 kcal/mol. The gaseous effluent of the reaction consists of CO_2 . (TTT)

18962

CONTRIBUTIONS TO THE TECHNOLOGY OF PHOSPHORS (NON-STOICHIOMETRIC COMPOSITION OF BATCHES AND FLUX FORMATION DURING THE CALCINATION).

Yu. S. Leonov (Lebedev Inst. of Physics, Moscow). *Zhur. Priklad. Khim.* **33**, 769-74(1960) Apr. (In Russian)

In investigating the previously studied Mn-activated Li-Mg tungstate system prepared by calcining a mixture of 1.13 g WO_3 , 0.25 g MgCO_3 and 0.5 g Li_2CO_3 with a Mn salt at 750°C for 20 min, it was found that the resulting phosphor consists of 2 phases, —one containing mixed tungstates, responsible for the luminescence phenomenon and an inert Li tungstate phase which cannot be activated by Mn. Although it would be expected that lowering the concentration of the inert phase would increase the luminescence, it was established that this is true only within certain limits, beyond which the intensity of the excited light decreases rapidly. The optimum composition corresponds to $2\text{Li}_2\text{O} \cdot \text{MgO} \cdot 1.26\text{WO}_3$. From data obtained by differential thermal analysis and x-ray diffraction it was found that the composition of the active phase is $2\text{Li}_2\text{O} \cdot \text{MgO} \cdot \text{WO}_3(\text{Mn})$. When preparing the material by calcining at 1200°C for 5 hr an exact stoichiometric mixture is required, while at the low temperature (800°C) calcination an excess of WO_3 must be present in the system. If the non-stoichiometric mixture is fired at 1200°C, the luminescence of the resulting product decreases if the calcination is extended beyond 7 min. (TTT)

18963

PREPARATION OF CALCIUM BY THE DISSOCIATION OF CALCIUM CARBIDE. A. S. Mikulinskii and F. S. Maron (Ural Chemical Research Inst., USSR). *Zhur. Priklad. Khim.* **33**, 835-41(1960) Apr. (In Russian)

The dissociation of CaC_2 was considered a convenient, cheap method for the preparation of elementary calcium and graphite. Technical grade $\text{CaO} + \text{CaC}_2$ mixtures were heated to temperatures ranging from 1600 to 1820°C at residual pressures of 0.5 to 1 mm of Hg. Compact metallic calcium containing 94.8 to 98.2% of the element and low ash content graphite with 97% C were obtained. It was established that the dissociation process occurs more easily than interaction of the carbide with CaO . (TTT)

18964

STUDIES ON THE SILICOTHERMIC PRÉPARATION AND ON CERTAIN PROPERTIES OF LANTHANUM DISILICIDE. V. S. Neshpor and G. V. Samsonov. *Zhur. Priklad. Khim.* **33**, 993-1001(1960) May. (In Russian)

In view of the interest in LaSi_2 for the fabrication of the carbides and borides of the transition metals, its preparation according to the reaction $\text{La}_2\text{O}_3(\text{solid}) + 7\text{Si}(\text{solid}) = 2\text{LaSi}_2(\text{solid}) + 3\text{SiO}(\text{gas})$ was investigated by heating compacts of the mixture of powders in vacuum and studying the phase changes by x-ray diffraction. The reaction is initiated at 1250°C and the amount of free Si remaining in the mixture decreases rapidly as the temperature is raised to

1580°C. Two distinct phases could be distinguished in the course of the reaction: at lower temperatures the formation of the monosilicide predominates, ultimately forming the disilicide by reacting with the free Si, while beyond 1500° and at a vacuum of 10^{-3} mm of Hg the La_2O_3 is reduced directly to LaSi_2 . The heats of formation of LaSi and LaSi_2 are approximately 64 and 52 kcal/mol, respectively, being close to the corresponding value of CeSi_2 . The microhardness of LaSi_2 is 324 kg/mm², lying below the microhardness of the other disilicides of the transition metals and of Si itself. This is explained by the disturbing effect of the La atoms escaping in the lattice vacancies of the Si network. In the temperature range 200 to 500°C the LaSi_2 behaves like a metallic conductor, becoming a semiconductor at higher temperatures. (TTT)

18965

CHEMICAL STABILITY OF BERYLLIUM BORIDES AGAINST ATTACK BY OXYGEN, NITROGEN AND CARBON AT HIGH TEMPERATURES. G. S. Markevich and L. Ya. Markovskii (State Inst. of Applied Chemistry, USSR). *Zhur. Priklad. Khim.* 33, 1008-12(1960) May. (In Russian)

The various Be borides, prepared by direct calcination of elementary powders, were found to have widely different resistances when heated to high temperatures in air and in contact with carbon. A typical parabolic weight loss versus time curve was obtained, corresponding to removal of B_2O_3 formed by oxidation and indicating the formation of a protective layer and the existence of a diffusion controlled reaction. The compounds containing the largest amounts of B, such as BeB_2 , BeB_4 , and BeB_6 were found to be the most stable, when compared to the Be-rich compounds Be_3B and Be_2B . Although the exact structure of the B-rich phases was not established, it may be assumed that they possess the complex spatial structure of boron, like the other hexaborides of the type MeB_6 , thus explaining the high temperature resistance. However, even the most stable Be borides are inferior to the borides of the transition metals which remain unaffected even when heated to 2000°C in the presence of C, while the Be borides carburize under those conditions in the temperature range 900 to 1300°, forming Be_2C and exhibiting a stronger affinity of the Be toward C than toward B. (TTT)

18966

THE COMPOSITION OF ANODIC GASES FORMED DURING THE PREPARATION OF ALKALI METALS BY THE ELECTROLYSIS OF MOLTEN SALT MIXTURES. S. A. Zaretskii and V. B. Busse-Machukas. *Zhur. Priklad. Khim.* 33, 1219-21(1960) May. (In Russian)

The O_2 and CO_2 mixtures which were noticed in the anode chamber during electrolytic decomposition of molten fluoride and chloride mixtures were ascribed to the discharge of ions containing O. Systematic studies were undertaken to establish the source of the O-containing materials by carefully following the course of the electrolysis; using porcelain containers, a graphite anode, and a molten Pb cathode; while preparing Pb-alkali metal alloys. After 3 to 4 hours of electrolyzing the NaCl-KCl mixture at 700° it was found that the originally 100% Cl content of the anodic gas was reduced to 98%. These studies showed that the presence of the O_2 and CO_2 observed in the mixtures can be explained by the fact that the alkali metals dissolved in the mixture reached the surface where they are oxidized and where the O-containing compounds of Si are reduced by interaction of the dissolved metal with the container material. It was thus established that the dilution of Cl was not due to the inflow of air due to lack of tightness. The electrolyte must be protected from contact with air and the container must be provided with a suitable liner. (TTT)

18967

THE INVESTIGATION OF HYDROGEN AND DEUTERIUM DESORPTION FROM PALLADIUM BY MEANS OF A PULSE MASS SPECTROSCOPE. Yu. I. Belyakov and N. I. Ionov (Inst. of Physics and Tech., Leningrad). *Zhur. Tekh. Fiz.* 30, 216-22(1960) Feb. (In Russian)

A mass spectrometer was used for investigating the formation of positive and negative ions in hydrogen penetration of palladium heated at 80 to 750°C. The experiments showed no evidence of either positive or negative ions. During heating, the desorption of hydrogen atoms did not exceed 1%. In addition to the initial material of equimolecular H_2 and D_2 , penetration through the film produced HD molecules. (R.V.J.)

Radiation Chemistry and Radiochemistry

18968

AD-227857

Ohio State Univ. Research Foundation, Columbus. THE CHARACTERIZATION OF PRODUCTS FROM IR-RADIATED CARBOHYDRATES. Report No. 4 (Final) for April 20, 1957-September 30, 1958. M. L. Wolf from. 41p. Project No. 7-84-01-002. Contract DA-19-129-QM-932.

A paramagnetic resonance study of irradiated crystalline carbohydrates is presented. G values were calculated for a number of irradiated carbohydrates. Irradiation of aqueous D-glucitol (sorbitol) yielded D-glucose, L-glucose, D-arabinose, and L-xylose. This was based on paper chromatography. Possible paths for these transformations are discussed. D-Arabinose was detected in the product of irradiated D-glucose. Simple carbonyl compounds were also present. Detection and characterization of organic acids in the irradiation product are in progress. The extent of hydrolysis of inulin, maltose, trehalose and raffinose by ionizing radiation is reported. The hydrolysis products were detected by chromatography and ionophoresis. (auth)

18969

AERE-HP/R-2084

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE RADIOCHEMICAL ANALYSIS OF LONG-LIVED RADON DECAY PRODUCTS AND THEIR USE AS NATURAL ATMOSPHERIC TRACERS. W. M. Burton and N. G. Stewart. May 1960. 34p. BIS.

Radiochemical separation methods were developed for the measurement of small quantities of RaD, RaE, and RaF collected on air filters and in rainwater. Chemical yields of 80% are obtained and the limit of sensitivity for the detection of these isotopes is about 10^{-12} curie. Less than 0.01% of the fission product activity collected in the original sample remains in the final separated fractions. The methods were used to measure the concentration of RaD and RaF in rainwater and in airborne dust collected at altitudes up to 48,000 feet above the U.K. The results of this preliminary study give useful information about atmospheric processes, and indicate that long-lived natural radioactivity is a valuable atmospheric tracer. (auth)

18970

AERE-M-667

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

EXPERIMENTAL TECHNIQUES IN THE STUDY OF THE

REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE UNDER RADIATION. N. S. Corney, W. R. Marsh, and J. Wright. Apr. 1960. 12p. BIS.

A discussion of purposes and merits of investigative procedures used in examining radioinduced CO_2 -graphite reactions is presented. (J.R.D.)

18971 CF-59-1-90

Oak Ridge National Lab., Tenn.

SOME EFFECTS OF RADIATION ON SOLVENT EXTRACTION PROCESSES. Wallace Davis, Jr. and Robert M. Wagner. Jan. 26, 1959. 14p. Contract [W-7405-eng-26]. OTS.

For presentation at the A. C. S. Convention, Boston, Mass., April 1959.

The yield of total acid, G_{acid} , in the radiolysis of tributyl phosphate-Amsco 125-82 solutions is 2.7 times the electron fraction of TBP, or approximately 2.7 times the weight fraction of TBP, per 100 ev of energy absorbed by the solution. Dibutyl phosphoric acid, DBPA, constitutes about 85% of the acid. Radiolysis of TBP also results in the conversion of about 0.9 molecules of TBP to a polymer per 100 ev of energy absorbed. Uranium extraction-stripping tests with an 8 stage spinner column have shown that one mole of uranium is retained in the organic phase during the stripping operation per mole of DBPA added prior to the extraction operation. On the basis of a tentative molecular weight of 843 g/mole, the polymer retains in the organic phase during stripping operations about 1.2 moles of uranium per mole of polymer added prior to extraction. In addition to polymer and acids, condensed phase radiolysis products include olefins, whose yield, expressed as $G_{\text{C}=\text{C}}$, or number of double bonds formed per 100 ev of energy absorbed, decreases from ca 4 to 1 as the TBP concentration increases from 4.5 to 100 wt.%. Diethyl carbonate (DEC) was tested for uranium retention and fission product decontamination properties. After irradiation to the 400 watt-hr/liter level, the uranium retention by DEC on stripping is decreased, rather than increased. Although γ -decontamination was adversely affected, β -decontamination was essentially unaffected by irradiation to this level. (auth)

18972 DEGR-132(W)

United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England. RADIATION-INDUCED FIXATION OF IODINE IN SOLUTIONS. T. Rigg. Mar. 3, 1960. 7p. BIS.

The presence of up to 1% of aromatic or olefinic hydrocarbon in 20% tri-*n*-butyl phosphate in kerosene containing iodine does not significantly affect the efficiency of radiation-induced iodine fixation. Fixation yields are greatest with pure *n*-dodecane and cyclohexane. With kerosene, yields are lower, presumably as a result of a protective effect involving energy transfer to an aromatic component. Increasing the aromatic content by the addition of 1% of benzene does not enhance this effect. It is considered unlikely that any paraffinic diluent will give lower iodine fixation than kerosene. Tri-*n*-butyl phosphate up to 20% w/v does not appear to affect the fixation yields. (auth)

18973 NAA-SR-4962

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SOME FACTORS CORRELATING THE RATES OF GAS FORMATION IN THE RADIOLYSIS OF AROMATIC HYDROCARBONS. J. G. Burr and J. D. Strong. July 15, 1960. 11p. Contract AT-11-1-GEN-8. OTS.

The logarithms of the relative yields of gas produced by the action of ionizing radiation on the purely aromatic

hydrocarbons have been found to be inversely proportional to the ionization potential, inversely proportional to the excitation energies, directly proportional to the conjugation energies, and directly proportional to the number of pi electrons in the molecules. These relationships provide a useful empirical means for predicting relative rates of radiolytic gas formation, and represent a systemization within which existing and future data may be compared and evaluated. The information which these relationships provide about the mechanism of radiolytic gas formation is also discussed. (auth)

18974 RCC/R-98

United Kingdom Atomic Energy Authority. Research Group. Radiochemical Centre, Amersham, Bucks, England.

RADIATION DECOMPOSITION EFFECTS IN AQUEOUS SOLUTIONS OF CARRIER-FREE SODIUM IODIDE I-131.

J. S. Burgess and E. J. Partington. Mar. 1960. 9p. BIS.

The factors influencing the oxidation of sodium thiosulfate (reducing agent) in carrier-free sodium iodide solutions were investigated. In the absence of an excess of reducing agent, the I^{131} is slowly oxidized to form iodate and iodine. The addition of 5×10^{-5} mM sodium thiosulfate per mc I^{131} was found to be sufficient to insure an excess of reducing agent. (C.J.G.)

18975 TID-5635

Stanford Research Inst., Menlo Park, Calif.

RADIATION STABILITY OF ORGANIC LIQUIDS. Semi-Annual Report No. 6 [for] July 1, 1959-December 31, 1959. R. M. Wagner and R. Farrand. Jan. 5, 1960. 15p. SRI Project No. SD-2080. For Oak Ridge National Lab. Subcontract 1081. OTS.

Irradiation effects on solvent systems and removal of fission products from solvents used in fuel element processing were studied. Eight Amsco-TBP solutions were equilibrated with water. The resulting water-saturated phases were separated and irradiated. Results showed that the presence of water enhanced acid production in up to 30% TBP and depressed it above 30%. Irradiation of nitric acid-equilibrated TBP-Amsco phases at two different temperatures indicated that radiolysis damage to nitric acid was temperature dependent and that $G(\text{MBP})$ and $G(\text{DBP})$ values were independent of nitric acid concentration. Irradiation of Amsco and Solvesso-100 showed that gas formation in Solvesso-100 was $1/4$ that of Amsco, but radiolytic induced carbon-carbon unsaturation was twice that of Amsco. DSBPP-Solvesso-100 was found to be 4 times as stable to acid production as TBP-Amsco. Irradiation of 1 M TBP-Amsco solutions, which were contacted with 0.3, 1, or 2 M nitric acid, indicated that nitric acid suffered preferential radiation damage. Both increasing dose and increasing acid concentration increased the rate of DBP to MPB conversion. Activated charcoal, used for decontamination of fission product-containing TBP-Amsco phases, produced decontamination factors (DF) for Ru which varied from 7 to 132, and for Zr and Nb DF values varied from 9.4 to 345. Simple centrifugation of organic materials gave DF values for Ru and Zr of 5.36 and 7.18; centrifugation plus $\text{Fe}(\text{OH})_3$ carrier gave values of 14.60 and 63.60; centrifugation plus $\text{Al}(\text{OH})_3$ carrier gave 70.2 and 59.60 as decontamination factors. Electrocoagulation was studied as a method of effecting coagulation of finely divided radioactive material. The molar ratio $\text{TBP}/\text{H}_2\text{O}$ was determined to vary from 6.86 to 1.58, as the molar TBP concentration in Amsco varied from 0.151 to 2.260. The molar ratio of $\text{TBP}-\text{HNO}_3$ varied from 2.58 to 3.01 as molar concentration in Amsco varied from 0.376 to 1.505. (M.C.G.)

18976 TID-5693

Aerojet-General Nucleonics, San Ramon, Calif.
OPERATION OF AN IN-REACTOR LOOP CAPSULE FOR THE DETERMINATION OF "G" VALUES FOR THE PRODUCTION OF NO_2 IN $\text{N}_2\text{--O}_2$ SYSTEMS. Revised Nov. 1959. 140p. OTS.

The results of in-reactor loop capsule experiments to determine the feasibility and economic potential of producing nitric acid by the nuclear nitrogen fixation reactor (NNFR) are given. The NNFR process uses the kinetic energy of fission fragments to fix nitrogen in the presence of oxygen for nitrogen dioxide. Equipment, techniques, and instrumentation were developed and perfected which permitted an in-reactor yield measurement using fissile smoke dispersed in a 4:1 nitrogen-oxygen gas mixture at 1000 psi and 200°C. Q quantum yield of 7.3 and 7.4 molecules per 100 ev (G values) was measured. On the basis of these data, the NNFR showed a payout time of 3.7 years or less, at an operating level of 107,000 tons per year of nitric acid. (C.J.G.)

18977 WADD-TR-60-127

Yale Univ., New Haven.
INVESTIGATION OF INITIAL FREE RADICAL YIELDS IN ORGANIC COMPOUNDS SUBJECTED TO GAMMA RADIATION. Randolph H. Bretton and Imre Zwiebel. Apr. 1960. 45p. Project 7021. Contract AF33(616)-5239. OTS.

Satisfactory analytical and operational procedures for the use of DPPH (diphenylpicrylhydrazyl) as a scavenger in free radical yield determinations were developed. These procedures are used to determine the free radical yields resulting from the irradiation of organic compounds in a cobalt-60 gamma source. A summary and discussion of the radiochemical theory relating to the problem are given, followed by a literature survey on the specific project of the irradiation of alcohols. The theory underlying the use of scavengers is presented and the results of a detailed study of the specific scavenger DPPH, are given. Preliminary results for the irradiation of ethyl alcohol and acrylonitrile are presented. (auth)

18978 JPRS-2733

STUDY OF THE INFLUENCE OF MOLECULAR STRUCTURE ON THE VELOCITY OF IONIC AND ATOMIC REACTIONS OF ISOTOPE EXCHANGES. IV. INVESTIGATION OF THE RADICAL-CHAIN REACTIONS OF ISOTOPE EXCHANGES OF IODIDE ALKYL WITH ELEMENTARY IODINE. M. B. Beuman, V. B. Miller, and Yu. M. Shapovalov. Translated from *Zhur. Fiz. Khim.* 30, 492-9(1956). 15p. OTS.

It is shown in the case of iodine-substituted hydrocarbons that the isomerization of alkyl radicals, as well as the substitution of hydrogen atoms in the molecule of CH_3I by atoms of iodine or by hydrocarbon radicals, accelerates the atomic reactions of isotope exchange. The velocity of the processes changes in atomic reactions of isotopic exchange in proportion to the variation of the strength of the bond of carbon with halogen. It is shown that equal changes of molecular structure influence the velocity of ionic and atomic reactions of isotope exchange differently. Structural changes in the molecule of alkyl halogen which cause a delay of ionic reactions, accelerate the reactions, which proceed according to radical-chain mechanism. (W.L.H.)

18979

RADIOCHEMICAL POLYMERIZATION OF HYDROCARBONS IN A NUCLEAR REACTOR. Ève de Gorski, Charles Walther, and Gabriel de Gaudemaris (Centre d'Études Nucléaires, Grenoble, France). *Compt. rend.* 250, 3658-9 (1960) May 30. (In French)

The polymerization of some hydrocarbons under the effect of the complex radiation of a swimming pool reactor was studied. The process of the reactions and the composition of the products obtained are identical to those which were obtained under the action of accelerated electrons. The radiochemical yield, however, is a little different. Diisobutylene of a commercial quality and briefly purified by distillation was the hydrocarbon studied. (tr-auth)

18980

INDIRECT CHEMICAL EFFECTS OF HIGH-ENERGY RADIATION IN ORGANIC SOLUTIONS. Alexander MacLachlan (E. I. du Pont de Nemours & Co., Wilmington, Del.). *J. Am. Chem. Soc.* 82, 3309-14(1960) July 5.

Compounds of the structure $\text{C}_6\text{H}_5\text{CH}_2\text{X}$, where X- is Cl, OH, HCOO- and $\text{CH}_3\text{COO-}$ but not H- or $\text{C}_6\text{H}_5\text{CH}_2\text{-}$, when irradiated as solutes (0.1 M) in cyclohexane with 2-mev electrons react with a $\text{G}(-\text{C}_6\text{H}_5\text{CH}_2\text{X}) \approx 4$. Evidence obtained by scavenger studies using iodine and cyclohexene, and by variation of dose, dose rate and solute concentration, indicates that this high radiation yield results from energy transfer to the solute from excited solvent. (auth)

18981

CARBON-14 RECOIL IN AZOBENZENE-STILBENE SOLID SOLUTIONS. John Y. Yang and Alfred P. Wolf (Brookhaven National Lab., Upton, N. Y.). *J. Am. Chem. Soc.* 82, 3315-18(1960) July 5.

Chemical effects of the nuclear transformation, $\text{N}^{14}(\text{n,p})\text{C}^{14}$, in azobenzene-stilbene were studied as a function of varying composition of the solid solution. It was observed that the yields of azobenzene- C^{14} and stilbene- C^{14} show a linear dependence on the mole fraction of the corresponding parent compound. Non-statistical carbon-14 distribution as a result of re-entry processes was found from degradation studies. (auth)

18982

HETEROGENEOUS NATURE OF REACTION IN RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF ACRYLAMIDE. George Adler and Walter Reams (Brookhaven National Lab., Upton, N. Y.). *J. Chem. Phys.* 32, 1698-1700(1960) June.

It has been suggested that the radiation-induced solid-state polymerization of acrylamide is a heterogeneous reaction, that is, it goes by a two-phase mechanism. According to this concept, the reaction proceeds at definite sites within the crystal, forming regions of pure polymer imbedded in pure monomer with further reaction at the interface between the two. In order to test this suggestion, a series of rotation diagrams (x-ray diffraction) was run on an acrylamide crystal in various stages of polymerization. The results indicate that the diagrams are a superposition of monomer and polymer patterns, and that the reaction proceeds by a two-phase mechanism. (D.L.C.)

18983

DETECTION OF SHORT-LIVED TRANSIENTS IN RADIATION CHEMISTRY. Max S. Matheson and Leon M. Dorfman (Argonne National Lab., Ill.). *J. Chem. Phys.* 32, 1870-1(1960) June.

Transients in solutions irradiated with a 5- μsec pulse of 15-Mev electrons (av. current = 0.1 amp) were observed by means of synchronized flash absorption spectroscopy. The following solutions were studied: 0.01 M benzyl chloride in cyclohexane, 0.01 M allyl chloride (aq), 0.01 M allyl alcohol (aq), 0.004 M 1,4-cyclohexadiene in cyclohexane, 0.007 M KI (aq), and 0.04 M KBrO_3 (aq). The absorption spectra of the transients in these solutions and their interpretation are given. (D.L.C.)

18984

CORRELATION OF MOLECULAR YIELDS IN HYDROCARBON RADIOLYSES WITH MASS SPECTRAL DATA.

Leon M. Dorfman and Myran C. Sauer, Jr. (Argonne National Lab., Ill.). *J. Chem. Phys.* **32**, 1886-7(1960) June.

Correlation of radiation chemical yields with mass spectral data was carried out for the molecular detachment yields of H_2 , CH_4 , and C_2H_2 in the gas-phase radiolysis of CH_4 , C_2H_4 , C_2H_6 , and C_3H_8 . Agreement between observed and calculated molecular yields is good and indicates that nonionized excited states, produced by electron impact, contribute little to these yields. (D.L.C.)

18985

POSSIBLE ION-MOLECULE REACTION IN THE GAMMA RADIOLYSIS OF C_3 HYDROCARBONS. Kang Yang (Continental Oil Co., Ponca City, Okla.). *J. Chem. Phys.* **32**, 1892(1960) June.

The ethane yields for the radical-free radiolysis (nitric oxide-inhibited) of gaseous propane, propylene, and cyclopropane were studied; only propane gave a measurable $G(C_2H_6)$, and it was constant within the range of energy absorbed. A mechanism for the formation of C_2H_6 is proposed, and it involves hydride-ion transfer: $C_2H_5^+ + C_mH_n \rightarrow C_2H_6 + C_mH_{n-1}^+$. (D.L.C.)

18986

RADIOLYSIS OF CYCLOHEXANE. I. PURE LIQUID CYCLOHEXANE AND CYCLOHEXANE-BENZENE SOLUTIONS. G. R. Freeman (Univ. of Alberta, Edmonton, Can.). *J. Chem. Phys.* **33**, 71-8(1960) July.

The radiation chemistry of pure liquid cyclohexane and of cyclohexane-benzene solutions was investigated. The cyclohexane radiolysis system appears to contain at least two distinct activated species, one of which ($c-C_6H_{12}''$) is subject to "protection" by benzene while the other ($c-C_6H_{12}'$) is not. The approximate yields of these two species, determined by kinetic analysis, are $G(c-C_6H_{12}'') = 3.0 \pm 0.4$ and $G(c-C_6H_{12}') = 2.4 \pm 0.4$. In addition to the usual products, cyclohexylcyclohexadiene and dicyclohexadiene were measured in the cyclohexane-benzene system. A mechanism was proposed to explain the formation of the major products and the variation of their yields with benzene concentration. A limiting case calculation for the upper limit of the rate constant for energy transfer between molecules in the present system (10^{13} to 10^{14} liters mole/sec) agrees well with a similar calculation, recorded in the literature, for energy transfer in organic solution scintillators. Another limiting case calculation shows that the rate constant for energy transfer might also be considerably smaller than the above value. (auth)

18987

CHEMICAL EFFECTS OF RADIATIVE NEUTRON CAPTURE IN $CrEn_3Br_3$. A. Turco (Università, Padua). *J. Inorg. & Nuclear Chem.* **13**, 200-11(1960) May.

The complex compound tris-ethylenediamine chromium(III) bromide was irradiated with neutrons in B.E.P.O. at Harwell. Depending on the conditions of irradiation, 5 to 40% of the activity was found on precipitation on lead chromate from aqueous solutions of the irradiated compound. On further separation using ion exchange columns and electrophoresis, it was shown that this activity was due to Cr^{61} not in the form of chromate, but in an unidentified species which co-precipitates with lead chromate. By exposing the irradiated sample to a source of γ -rays it was shown that this unknown species is formed by γ -annealing in the reactor. The significance of the patterns of electrophoretic separation is discussed and the peaks

are tentatively identified. Under the condition of this investigation, no evidence was obtained for an internal γ -conversion effect for Cr^{61} . (auth)

18988

CHEMICAL STATE OF RADIOCHLORINE FORMED BY THE $^{41}K(n,\alpha)^{38}Cl$ REACTION. M. Vlatković and A. H. W. Aten, Jr. (Inst. for Nuclear Physics Research, Amsterdam). *J. Inorg. & Nuclear Chem.* **13**, 331-2(1960) May.

In the study of the Szilard-Chalmers process, an observation was made of the difference between the fate of radio-halogen in chlorate and iodate crystals after irradiation with thermal neutrons. Potassium iodate was irradiated to form Cl^{38} in a surrounding of iodate ions in order to determine whether the difference should be attributed mainly to the chemical properties of the radio-halogen or to those of the crystal lattice. Results indicated that the Cl^{38} was present as chloride ions or possibly atoms. Less than 1% of the chlorine activity was found in the chlorate fraction. Thus radiochlorine in an iodate lattice behaves similarly to radiochlorine in a chlorate lattice. (B.O.G.)

18989

THE REACTION OF HOT HYDROGEN ATOMS WITH CARBOXYLIC ACIDS. Ali M. Elatrash, Russell H. Johnsen, and Richard Wolfgang (Florida State Univ., Tallahassee). *J. Phys. Chem.* **64**, 785-91(1960) June.

The reaction of tritium atoms with a number of liquid carboxylic acids was studied. Recoil tritium from the nuclear reaction $Li^6(n,\alpha)H^3$ was used as the source. Labeled hydrogen (HT), tritium labeled parent acid, CH_3T and other labeled degradation products which may be formed by the replacement of an atom or group by a tritium atom account for nearly the entire yield. These products are, with the exception of HT, insensitive to the presence of I_2 as a radical scavenger. This suggests that the primary reaction of hot atoms in the gas phase—a high-energy fast displacement mechanism—is also operative in the liquid phase. The distribution of products reveals that a hot displacement reaction may take place at any type of bond and that its probability is proportional to the number of bonds of that type. Several trends among these competitive modes of displacement attack emerge clearly: e.g., attack on C-H is more likely than on C-C; attack on C-H yields more HT than labeled acid, especially with secondary C-H bonds; etc. The stability of a labeled species toward dissociation due to excitation introduced by the displacement reaction has a detectable effect on the yield pattern. Comparison with data on tritium reactions with gaseous hydrocarbons suggests that the same simple mechanistic model of the hot displacement process is applicable to both phases. (auth)

18990

RADIOLYSIS OF TRINITROMETHANE IN AQUEOUS SOLUTIONS BY Co-60 γ -RADIATION. A. Henglein and J. Langhoff (Univ. of Cologne). *J. Phys. Chem.* **64**, 830-1(1960) June.

In order to understand better the action of tetranitromethane as a radical scavenger, the radiolysis of trinitromethane(I) and dinitromethane(II) in aqueous solution was studied using Co^{60} γ radiation. Some of the results are presented in the form of G(decolorization vs pH plots, with G(I) being derived from measurements of the decolorization at 350 m μ , the position of the absorption maximum due to I. At pH 14, G(I) is ca. 2.8 molecules/100 ev, which corresponds to G(OH), and increases with decreasing pH up to the value of 8.2 at pH 0. In alkaline solutions of I, the 350 m μ peak becomes less intense and

is shifted to longer wavelengths upon irradiation; this shift indicates the formation of II with an absorption peak at 363 μ . In acid solutions of I, no II forms, but a peak appears at 315 μ which is ascribed to the formation of dinitro-formaldoxime, $C(NO_2)_2NOH$ (III). Addition of alcohols to I retards both the decolorization and shift of the 350 μ peak. Possible mechanisms for the formation of II and III from I are discussed. (D.L.C.)

18991

EFFECT OF A NOBLE GAS ON THE LABELING OF n -HEXANE BY EXPOSURE TO TRITIUM. A. Y. Mottlau (Esso Research and Engineering Co., Linden, N. J.). *J. Phys. Chem.* 64, 931-3(1960) July.

The effects of a noble gas on the labeling of n -hexane by exposure to tritium were studied. Data indicated that argon dilution increased by almost 40% the proportion of tritium incorporated in the C_6 fraction. The specific activity of the product increased from 71 to 92 mc/ml. Doubling the amount of argon in the system caused no further improvement and there appeared to be an optimum concentration beyond which a serious reduction in the total amount of tritiation is experienced. (M.C.G.)

18992

EFFECTS OF pH AND THE NATURE OF THE PRIMARY SPECIES IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS. J. T. Allan and G. Scholes (King's Coll., Newcastle-on-Tyne, Eng.). *Nature* 187, 218-20(1960) July 16.

Results are reported from a study of the effects of pH in *vacuo* on the yields from aqueous solutions of isopropanol solutions exposed to gamma radiation. Results indicate that polarons contribute to the molecular hydrogen yield. (C.H.)

18993

CHROMATOGRAPHIC SEPARATION OF RARE EARTH RADIOACTIVITIES. G. B. Maslova, P. P. Nazarov, and K. V. Chmutov. *Zhur. Neorg. Khim.* 5, 359-65(1960) Feb. (In Russian)

The short-lived fission product rare earths of La, Ce, Pr, Nd, Pm, and Y were completely separated on a sulfonated polystyrene resin (KU-2), 0.12 to 0.10 mm mesh size, on a column 100 cm long and 0.65 cm in diameter. The rate of elution was 0.5 ml/min cm^2 . The eluting agent was 0.25 M lactic acid at a pH of 4.0. It was also found that elution with 0.01 M pyrophosphoric acid (pH 5.2 - 8.0) separated the rare earths as effectively as lactic acid. Up to 90 per cent of a negative complex of cerium with pyrophosphate can be adsorbed on an anion exchanger, while lactic acid forms no negative complexes with cerium, since cerium is not adsorbed by the anion exchanger EDE-10 from aqueous solutions containing lactate ion. Experiments were carried out at a constant ionic strength (0.5 M NaCl) and a temperature of 25° to determine the stability of the cerium lactate complexes present in solution. Corrections were made for the swelling of the resin. The method of calculating the constants was taken from a paper by Froneus. It was found that cerium formed the following lactate complexes: $[Ce(CH_3CHOHCOO)]^{2+}$ ($K_1 = 242$), $[Ce(CH_3CHOHCOO)_2]^+$ ($K_2 = 22 \pm 12$), and $[Ce(CH_3CHOHCOO)_3]^0$ ($K =$ a few units). Comparative values for the doubly-charged positive complex are 282 ± 20 for Ce, 407 ± 20 for Nd, and 436 ± 20 for Y. (TTT)

18994

TRUDY I VSESOYUZNOGO SOVESHCHANIYA PO RADIATIONNOI KHIMII 25-30 MARTA, 1957. (Reports of the First All-Union Conference on Radiation Chemistry, March 25-30, 1957). Moscow, Publishing House of Academy of Sciences, 1958. 330p.

Fifty-six papers are included on initial radiation chemistry processes; radiation chemistry of aqueous solutions; radio-electrochemical processes; radiation effects on elements participating in biochemical processes; radiation chemistry of simple organic systems; radiation effects on polymers; and sources of radiation. (R.V.J.)

18995

BEITRÄGE ZUR METHODIK DES ARBEITENS MIT RADIOAKTIVEN ISOTOPEN IN DER ORGANISCHEN CHEMIE UND BIOCHEMIE. (Contribution to Methods for Working with Radioactive Isotopes in Organic Chemistry and Biochemistry). Helmut Simon. Berlin-Charlottenburg, Ger., Technische Universität, [1960]. 67p.

A method is given for determination of radioactive carbon in the gas phase. It is possible with this method to determine the C and H content of a compound simultaneously with usual analytical accuracy. The gas is always selected so that it is a good counting gas for proportional counting tubes. The method has an average error per determination of $\pm 0.5\%$ when the radioactivity is high enough. A different procedure for determination of T in the gas phase is given. The method has an average error of $\pm 0.5\%$ per single determination. A "memory-effect" free process for T analysis as well as for simultaneous determination of T and C^{14} in double-labeled materials is described. It was found that for such substances the Wilzbach process produces a useful counting gas for T determination. Using a T exchange method, a process for determination of active H in non-volatile substances is given. Finally, a method is reported with which it is possible to determine the specific radioactivity of C^{14} labeled compounds on paper chromatograms, in cases where the substance is non-volatile and has exchangeable H. (tr-auth)

18996

PRODUCING LUBRICATING OILS BY IRRADIATION. (to Esso Research and Engineering Co.). British Patent 840,825. July 13, 1960.

A process is presented for producing lubricating oils from select hydrocarbon mixtures by irradiation. A mixture of hydrocarbons having a boiling range from 300 to 700°F and containing 60 to 95 wt.% unsaturated hydrocarbons, 5 to 40 wt.% unsaturated straight chain hydrocarbons, less than 2 wt.% aromatics, and less than 25 wt.% naphthenes is exposed to neutron and gamma radiation of energy above 1 Mev. The mixture is exposed in the temperature range 100 to 600°F at a dose rate of at least 1 equivalent megaroentgens per hr, until at least 1 to 1,000 equivalent megaroentgens have been absorbed. Then the mixture is recovered. (W.L.H.)

Raw Materials and Feed Materials

18997 MCW-1371

Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. A. E. Ruehle, J. U. Shepardson, et al. Jan. 1, 1955. Decl. Mar. 7, 1960. 74p. Contract W-14-108-eng-8. OTS.

New materials studied to determine their amenability for processing in the refinery include Monticello furnace brick, Australian Rum Jungle ore, and Radium Hill concentrate. Nitric acid proved satisfactory for leaching U from graphite crucibles and molds used in plant operations. Data are presented from studies of the solubility of sodium uranyl vanadate in simple synthetic solutions; development of a reactivity test for UO_3 based on the amount of unhydrofluorinated oxide remaining after standard conditions of

reduction and hydrofluorination; laboratory investigation of carbonate leaching of reject slag for the recovery of U; the effect of oxidizing agents on ion exchange recovery of U from carbonate slag leach solutions; the internal effects of varied firing conditions on the U metal produced in the flange bomb as demonstrated by macroscopic and Tukon hardness tests and nitrogen study; the distribution and possible means of elimination of the hydrogen contamination in derbies, dingots, and ingots; results of hydrogen analysis using a vacuum fission method; metallographic information on samples obtained at other sites; design of a vacuum-fusion apparatus; the preparation of anhydrous thorium chloride by the chlorination of thorium oxide with a mixture of sulfur monochloride vapor and chlorine gas; the magnesium reduction of anhydrous thorium chloride; and a study of the possible effect of spectroscopic electrode impurities on results in determinations of B in graphite. (For preceding period see MCW-1369.) (C.H.)

18998 MCW-1401

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. LABORATORY WORK. Nona Kuhlman, ed. Apr. 1, 1957. Decl. Mar. 31, 1960. 128p. Contract W-14-108-eng-8. OTS.

Work continued on raw materials, extraction, green salt, the fluoride volatilization process, metal quality, and analytical projects. Investigation of a method of recovering scrap metal was begun during this period. Investigations with the Uravan feed lot previously shown to contain a significant quantity of insoluble uranium indicated that the amount could be decreased by grinding the ore, lengthening the digestion time, or adding hydrochloric acid to the digest liquor. The total quantity of other insolubles was not affected. Equilibrium distribution data between 25% (v/v) TBP-hexane and aqueous solutions containing various amounts of uranium, nitric acid, and lithium nitrate were measured. The importance of incomplete re-extraction as a limitation on the uranium recovery from raffinate was demonstrated experimentally and by calculation. Indications of a correlation between the reflectance spectra of orange oxide preparations, and their reactivity toward reduction and hydrofluorination was found. The properties of UO_2 prepared from vacuum denitrated amorphous UO_3 were examined. Small scale preparations of uranium hexafluoride using both wet and dry intermediate hydrofluorination gave products meeting cascade grade specifications for boron, chromium, phosphorous, and silicon. The vanadium content of these preparations was too high, and the molybdenum may have been above specification. Scoping work on an alternative process for recovery of contaminated scrap metal was started. This process involves purification by precipitation of $\text{UF}_4 \cdot \frac{3}{2}\text{H}_2\text{O}$ as a substitute for the current practice of running this type of scrap through the complete purification cycle. A good inverse correlation was obtained between the central temperature of the bomb charge just before firing and the hydrogen content of the metal produced. Use of magnesium prefilmed with hydrogen fluoride consistently resulted in decreased hydrogen content of the product metal. Filmed magnesium was found to contain on the average $\frac{1}{8}$ as much total hydrogen as production grade material. The range of a quick control method for determining nitrate in uranium trioxide was extended for operation between 0.7 and 8.7% nitrate. Gas-liquid partition chromatography was applied to the separation and determination of components of mixtures of hexane isomers. Suitable column packings which yield complete isomeric separation have not yet been found. (For preceding period see MCW-1399.) (J.R.D.)

18999 MCW-1450

Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.

THE UTILIZATION OF THE $\text{HF}-\text{H}_2\text{O}$ AZEOTROPE IN THE MANUFACTURE OF URANIUM TETRAFLUORIDE. L. G. Weber. July 18, 1960. 12p. Contract W-14-108-eng-8. OTS.

This paper was presented at a local symposium sponsored by the St. Louis Section of the AIChE, March 15, 1960.

A process for the recovery and recycle of waste hydrofluoric acid arising from the manufacture of uranium tetrafluoride is described. Particular problems in the choice of materials of construction and startup of a full scale plant unit based on this process are discussed. The results of recycling the recovered acid showed high levels of conversion at high production rates. (auth)

19000 MCW-1453

Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.

SOLUBILITY AND DISTRIBUTION STUDY OF ANTIMONY, TANTALUM, NIOBIUM, RUTHENIUM, TUNGSTEN, AND TITANIUM. S. D. Nelson and G. P. Lang. July 29, 1960. 10p. Contract W-14-108-eng-8. OTS.

The solubilities and extractions of antimony, tantalum, niobium, ruthenium, tungsten, and titanium under conditions existing in the Weldon Spring uranium refinery were studied. The maximum amounts of these elements that would be expected to report in the uranium trioxide are, in most cases, orders of magnitude below 1 ppm. Tungsten would probably be the most difficult purification problem in the group. A summary of the concentrations of these elements found in domestic uranium concentrates is also given. (auth)

19001 NLCO-565

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1955 TO JUNE 30, 1955. John W. Simmons, ed. July 15, 1955. Decl. Mar. 31, 1960. 170p. Contract AT(30)-1156. OTS.

Progress is reported on the following investigations: pilot plant studies of the processing of several U concentrates; evaluations of the refinery and denitration-acid recovery processes; preparation and processing of UF_4 ; operation of the moving-bed reactor; reduction of UF_4 and U casting; recovery of U from scrap materials; thorium development; and analytical procedures involving NO_3^- , SO_4^{2-} , ThO_2 , C, Th, U, Ni, Pb, Fe, Sn, Zn, and the rare earths. (J.R.D.)

19002 NLCO-577(Rev.)

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD JULY 1, 1955 TO SEPTEMBER 30, 1955. John W. Simmons, ed. Oct. 17, 1955. Decl. Apr. 28, 1960. 135p. Contract AT(30-1)-1156. OTS.

Progress is reported on the following investigations: pilot-plant evaluation of U ore concentrates; low-acid extraction of U; scrub-column operation, corrosion of reactor materials in sparge tanks containing UNH; effect of UO_2F_2 content on UF_4 reduction; thermal densification of UF_4 ; operation of the moving bed reactor; reduction of UF_4 with Mg; development of a mold insulator; preparation of Th (C_2O_4)₂ and ThCl_4 ; production of Th metal; β transformation of U; effect of H_2 content of slug canning behavior; centrifugal casting of slugs; determination of Zr and Mo in U alloys; and analysis of U and Th ores for rare earths. (W.L.H.)

19003 NLCO-601

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1955 TO DECEMBER 31, 1955. VOLUME II. John W. Simmons, ed. Jan. 16, 1956. Decl. Apr. 28, 1960. 96p. Contract AT(30-1)-1156. OTS.

Progress is reported on the preparation of ThCl_4 from Th oxalate, induction melting of Th scrap, pressing of Th sponge scrap into electrodes, development of the process for centrifugally casting fuel cores, preparation of U shot, mechanical resonance testing of U slugs, use of sonotest for testing slugs for grain size, design of thermal balance, determination of the density of U metal, effects of air exposure on Mg metal, effect of atmospheric conditions on the measurement of moisture content of U ore concentrates, processing of U ores, determination of rare earths in U materials, and the determination of radium with high-pressure ionization chamber. (J.F.D.)

19004 NLCO-625

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1956 TO MARCH 31, 1956. John W. Simmons, ed. Apr. 16, 1956. Decl. Mar. 31, 1960. 164p. Contract AT(30-1)-1156. OTS.

Studies were continued on the laboratory evaluation of Canadian gravity concentrate, processing of Th-containing U concentrates, extraction of U in a HNO_3 -TBP-UNH system, corrosion rates of stainless steel in 70% HNO_3 , denitration process, corrosion resistance of chrome-plated drum dryer to raffinate solutions, UO_2F_2 reduction process, process studies in the UO_3 to UF_4 process, effects of reduction temperature and degree of hydration on reactivity of UO_2 pellets, conversion of ammonium diuranate to UF_4 , reduction of UF_4 , melting and casting of Nb-U alloys, production of U washers, recovery of U from scrap material, and fabrication of Th electrodes. New processes, special problems, and wet chemical and spectrochemical development were considered. (For preceding period see NLCO-601.) (J.R.D.)

19005 NLCO-640

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1956 TO JUNE 30, 1956. John W. Simmons, ed. July 18, 1956. Decl. May 12, 1960. 156p. Contract AT(30-1)-1156. OTS.

Progress is reported on the following: processing of U concentrates and extraction of plant solutions with urea; denitrations of $\text{UO}_2(\text{NO}_3)_2$ to UO_3 ; recovery of HNO_3 from raffinates; hydrofluorination of UO_2 to UF_4 , reduction of UF_6 to UF_4 with NH_3 ; operation of moving-bed reactor for conversion of UO_3 to UO_2 ; production of U from UF_4 ; melting and casting of U and U alloys; nitric acid dissolution of U; recovery of U from scrap materials; preparation of U shot; and miscellaneous analytical procedures. (C.W.H.)

19006 NYO-1366

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. A. E. Ruehle and J. U. Shepardson. July 1, 1954. Decl. Mar. 7, 1960. 122p. Contract W-14-108-eng-8. OTS.

Progress is reported on the following investigations: processing of Livingston concentration, leaching of low-grade Colorado intermediates with metallic salt solution, methods for processing synthetic carnotites, effect of sulfate and fluoride ions on ether extraction of $\text{UO}_2(\text{NO}_3)_2$, effect of chloride and phosphate on extractability of U in diethyl ether, solubility of sodium vanadate in NaOH solu-

tions, reversion of Florida green salt to an acid-soluble form, digestion of American Cyanamid resin in pulp material, recovery of U and Sc from U refinery raffinates, reduction of uranium oxides with Mg, electrolytic process for production of U, testing of coatings for ceramic crucibles for melting U, methods for examining inclusions and striations in U, x-ray fluorescence determination of U in slag, the use of ethylenediaminetetraacetic acid in the separation of U as uranyl ammonium phosphate, moisture characteristics of Beaver Lodge precipitate, and the spectrophotometric determination of Cr in U compounds. (For preceding period see NYO-1363.) (J.E.D.)

19007

PROCESS FOR THE PRODUCTION OF URANIUM TETRAFLUORIDE FROM URANIUM RAW MATERIAL. (to Mitsubishi Kinzoku Kogyo Kabushiki Kaisha). British Patent 837,083. June 9, 1960.

A process is presented for the production of UF_4 from U raw material. The process consists of dissolution and leaching with sulfuric acid, reduction of ferric iron, extraction by an organic solvent, stripping with sodium carbonate, electrolytic reduction, and precipitation with HF. (W.L.H.)

Separation Processes**19008 ANL-5730**

Argonne National Lab., Ill.

CHEMICAL ENGINEERING DIVISION SUMMARY REPORT [FOR] JANUARY, FEBRUARY, AND MARCH 1957. Decl. Mar. 21, 1960. 132p. Contract W-31-109-eng-38. OTS.

Fluoride Volatilization Separations Process. Development of a fused fluoride process for dissolution of uranium-zirconium fuel alloys continued. In corrosion tests to find a suitable container material, Ni was found to be susceptible to a sulfur-type attack. Hastelloy B showed promise, and graphite offers excellent chemical resistance but poor mechanical strength. The dissolution rate of Zr in NaF-ZrF₄ as affected by impingement of the HF sparge was studied. Production of UF_4 by fluidized bed fluorination of UF_4 from ore concentrates was studied. The preparation, melting point, vapor pressure, and vapor density of VF_5 are given. Preliminary dissolution and recovery runs in semi-works equipment are discussed. Fluidization. Fluidized-bed techniques have been applied to conversion of $\text{UO}_2(\text{NO}_3)_2$ to UF_4 and to calcination of radioactive liquid wastes. Activities of the Green Salt Pilot Plant and shakedown runs of the shielded waste calciner are described. Reactor Chemistry. Studies continued on the kinetics and mechanism of oxidation of U, Th, and Zr. Data are given for oxidation of U in oxygen from 125 to 295°C and 20 to 800 mm pressure, and for Zr from 400 to 900°C and 200 mm O_2 pressure. The ratio of capture to fission cross sections for U^{235} and U^{238} in EBR-I have been determined as a function of position. Chemical-Metallurgical Separations Processes. Development of pyrometallurgical processing of spent reactor fuels continued. Work is reported on: melt refining and casting of U-Pu; iodine volatility problem; the system U-B-Ta; the distribution coefficients for Pu between U-Cr and Mg and U and Mg; extraction of Pu from U by liquid Mg; Ce removal by dross refining; adsorption of volatilized metals on surface active materials; and fractional crystallization of U with Zn. Analytical Research. A study of the behavior of radionuclides with HF and HF-methyl ethyl ketone in ascending paper chromatograms is described. (T.R.H.)

19009 CF-57-3-80

Oak Ridge National Lab., Tenn.

TBP STRIPPING IN BUBBLE-CAP COLUMN AND CON-

COMITANT PRODUCT EVAPORATION. J. T. Long. Mar. 18, 1957. 15p. Contract [W-7405-eng-26]. OTS.

A study was conducted to demonstrate the stripping and evaporation steps in a Purex-type uranium recovery process and to ascertain the operating behavior of the equipment under a range of conditions. The factors considered were control, effectiveness, and reliability of equipment and optimum feed point. Experimental procedures are described, and recommendations for equipment modifications are included. (J.R.D.)

19010 CF-58-2-139

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, FEBRUARY 1958. J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. June 27, 1958. 53p. Contract W-7405-eng-26. OTS.

Calibrations have resulted in conflicting data for the yield of neutrons from a teflon-polonium solution interface. The installation of the continuous DRUHM reaction system is approximately 60% complete. The Fluorox fluidized bed reactor was operated continuously for 12 hr, producing 1.6 kg of UF_6 . In homogeneous reactor studies, installation of a mock-up for in-pile slurry bomb heat removal tests was completed. From material balances, about $2\frac{1}{2}$ g of plutonium remain in loop P-1 after repeated washing and descaling treatments. A Sharples Model P-4 Super-D-Canter was adequate for continuously discharging ThO_2 cake and clarified supernate. In ion exchange studies, data were obtained on the complex ion equilibria in uranyl sulfate solutions. A continuous self-sustaining Darex dissolution and stripping run of 46 hr duration was made. In a hydrochlorination run of 35 hr duration, 97.4% of a 4.39 kg section of a STR subassembly was reacted with anhydrous HCl gas with a uranium loss to the sublimate of 0.095%. The studies of the dissolution of dummy zirconium fuel elements in fused salt with HF were continued at increased HF velocities. In waste processing studies, the design of an adiabatic self-sintering experiment is 90% complete and the construction of the field facilities is 50% complete. (For preceding period see CF-58-1-137.) (auth)

19011 CF-58-3-71

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS MONTHLY PROGRESS REPORT, MARCH 1958. J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Aug. 12, 1958. 72p. Contract W-7405-eng-26. OTS.

The alpha activity for scintillation area measurement was estimated to be 10^{-6} of that for the (α, n) method. The UF_6 recovery during Run FBR-16 was 67.3% of the theoretical recovery for the Fluorox reaction. Hydroclones were used for collection of thorium slurries with recoveries exceeding 99%. Flame calcination studies were continued with thorium dispersed in methanol by oxalic acid, using graphite and zirconia reflected burners and acetylene-oxygen flame. Equations for complex ion formation in $UO_2SO_4-H_2SO_4-Na_2SO_4-H_2O$ systems were solved for a few hypothetical solution compositions. A continuous Darex dissolution and stripping run was carried out for 32 hours with chloride removal in the product to 100 ppm. A nine pound section of a fuel element was completely hydrochlorinated in 24 hours with an HCl utilization of 70% and uranium losses to the $ZrCl_4$ sublimate of 0.07%. The specific dissolution rate for the fused salt dissolution of Zircaloy-3 was proportional to the logarithm of the HF feed rate. One percent of the initial β activity and fourteen percent of the initial γ activity was leached by distilled water

from a 900°C fired sinter of concentrated fission products in a mix of shale and limestone (Mix 15). (For preceding period see CF-58-2-139.) (J.R.D.)

19012 CF-58-4-123

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, APRIL 1958.

J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Sept. 10, 1958. 65p. Contract W-7405-eng-26. OTS.

A study of interface diffusional resistance for Purex type solvent extraction systems was proposed using a light transmission technique. Uranium hexafluoride was reduced to metal by sodium with an 82% yield and a maximum metal purity of 98%. In two fluidized bed runs at 800°C more than 3 kg of UF_6 was produced by oxidation of UF_4 with $\frac{2}{3}$ of theoretical recovery. Flame fired thorium and physical properties at least equal to those of 1600°C furnace calcined product. Initial uranium sorption rates on anion resin from sulfate solutions were 50-100 mg U/min/g dry resin and decreased sharply until the resin loading was 30 to 50% at which time the rates were 5 to 10 mg/min/g. In a Darex run of 47 hr duration using 70 wt.% nitric acid stripping vapor at $V/L = 0.95$, chloride was removed to 50 ppm with losses of approximately 0.15 moles HCl and 0.6 moles HNO_3 per mole of SS dissolved. A Zircex run of 12 hr duration was made in which 97.8% of a 4.21 kg section of a fuel subassembly was reacted with an HCl utilization efficiency of 78%. Glass-coated mild steel and Hastelloy C were not visibly damaged by irradiation to 10^{10} r (γ), but glass coatings on stainless steel and Inconel had reduced adherence. Zircaloy-3 was attacked at approximately 800°C by anhydrous HF at a maximum rate 10.9 mg/sq cm/min in the absence of fused salt. A wetting agent increased the efficiency of caustic bubblers for removal of radioactive aerosols. (For preceding period see CF-58-3-71.) (auth)

19013 CF-58-5-50

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, MAY 1958.

J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Sept. 25, 1958. 67p. Contract W-7405-eng-26. OTS.

A completely non-metallic pump was fabricated for the circulation of polonium-contaminated fluorocarbon. Three semi-continuous DRUHM runs were made to test inlet nozzle designs. Approximately 11 lb of UF_6 were produced during a 12-hr Fluorox run in the new 4-in. fluid bed reactor. Thorium oxalate was precipitated by oxalic acid in the presence of amines such as ethylenediamine as very regular cubes which persisted through calcination to ThO_2 . Use of He-air mixtures in an annulus to give a controlled heat transfer resistance gave excellent temperature control for an ORR slurry bomb mockup. The ionic compositions of a limited range of $UO_2SO_4-H_2SO_4-Na_2SO_4-H_2O$ solutions were calculated with the aid of an IBM 704 computer. Two continuous Darex runs of 5- and 20-hr duration were made in which 22 and 75 ft of prototype Yankee Atomic fuel were dissolved with losses of approximately 1.0 mole HNO_3 and 0.2 mole HCl per mole of metal dissolved. In a 14-hr Zircex run, 98.7% of a 4.36 kg section of a fuel subassembly was reacted using HCl passed through an activated charcoal bed; the HCl utilization efficiency was 75%. A test dissolution of Zircaloy-2 employing NaF and LiF as the fused salt mixture was carried to completion at an average rate of 5.56 mg/(min)(sq cm) with 2.0 lb/hr HF feed rate. A series of five runs was made to determine the amount of fission products vola-

tilized from a clay matrix as a function of drying temperature from 150 to 1150°C. (For preceding period see CF-58-4-123.) (auth)

19014 CF-58-6-85

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JUNE 1958.

J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Oct. 9, 1958. 66p. Contract W-7405-eng-26. OTS.

The interfacial area in a pulse column was measured using an α, n reaction. Externally mixing atomizing nozzles were tried unsuccessfully in the DRUHM reactor. A Fluorox run gave a UF_6 recovery of 72.9% of the theoretical yield and rate constants of 18.6 hr^{-1} and 32.9 hr^{-1} . Satisfactory operation of a flame calcination apparatus was demonstrated with methyl alcohol feed slurries of thorium oxalate, with ethylorthosilicate treated ThO_2 , and with 650°C fired ThO_2 . Thorium dioxide was efficiently collected from circulating slurries using a hydroclone and an induced underflow receiver. Tests show that classification of thorium dioxide with hydroclones is practical. The Darex equipment is being modified to provide automatic adjustment of recycle acid streams. Two Zircex hydrochlorination runs were made with HCl utilization of 55%, uranium losses to the sublimate of 0.057% and 5.1% insoluble losses. Methods for disassembling SRE Core 1 fuel elements were explored. Bench scale equipment to test a flowsheet for the reprocessing of irradiated PWR blanket fuel elements has been installed in cell 2 of building 4507 and tested for leaks and operability. Tests on radiation damage of protective coatings and glass-lined equipment were continued. Experiments have demonstrated that dry salt mixtures of LiF and NaF instead of molten mixtures might be charged to the Volatility pilot plant hydrofluorinator. The concentration of Darex and Sulfex waste by evaporation was studied. (For preceding period see CF-58-5-50.) (auth)

19015 CF-58-9-62

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, SEPTEMBER 1958.

J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Nov. 18, 1958. 38p. Contract W-7405-eng-26. OTS.

The feasibility was demonstrated of the use of liquid-organic scintillators in contact with an alpha emitting aqueous phase for the measurement of interfacial area in a mixer. The transpiration flow of pure water reduced the corrosion by a factor of 60 of a porous nickel tube by $FeCl_3$. One continuous DRUHM reaction study was made in which poor product consolidation resulted from a less than optimum sodium feed rate. In Fluorox run FBR-19, an over-all material balance of 102% and a UF_6 balance of 97% was obtained, with a UF_6 recovery of 71%. The flame denitration of a thorium-uranium nitrate solution in an oxygen acetylene flame was carried out successfully to produce a mixed oxide of 1.5 micron mean particle size with a surface area of 5.8 m^2/g . Cylindrical hydroclones were tested for the collection of circulating thoria slurries. In the determination of the uranium loading of anion exchange resin a predicted maximum loading at a sulfate concentration of approximately 0.04 M was not found in preliminary experiments. A continuous Darex run was carried out with sections of prototype APPR plates and was frequently interrupted due to the deposition of siliceous material in the stripping column. A Zircex run was carried out with commercially available HCl gas containing oxygen rather than carbon dioxide as the major impurity, resulting in compa-

rable uranium losses due to the formation of aqueous insoluble oxide solids. Simulated "25" waste was evaporated as a neutralized and unneutralized solution, giving condensates which were 0.5 M and 4 M in acid, respectively. (auth)

19016 CF-58-10-90

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, OCTOBER 1958.

J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Dec. 19, 1958. 47p. Contract W-7405-eng-26. OTS.

Tungsten and graphite are unsuitable materials of construction for a UF_6 inlet nozzle in a continuous DRUHM reactor. Preparation of feed was completed for an extended Fluorox test. Difficulties were experienced in the operation of a fluidized bed TbNT denitrator. Flame denitration of UNH and TbNO produced mixed oxides of 1 to 14 micron mean particle size. The chloride capacity of Dowex 21K was measured, and equilibria measurements of uranium sorption from sulfate solutions were continued. Siliceous deposits in the stripping column caused the termination of a Darex run with a prototype APPR fuel element. Hot runs were begun on the chemical dejacketing of irradiated PWR blanket pins. The addition of formaldehyde to neutralize "25" waste reduced the recovery of nitrate from the calciner off-gas from 76% to 23%. (For preceding report see CF-58-9-62.) (auth)

19017 CF-59-3-75

Oak Ridge National Lab., Tenn.

EFFECTS OF FUEL BURN-UP ON THE DISSOLUTION PROCESS-I. W. Davis, Jr. Mar. 25, 1959. 9p. Contract [W-7405-eng-26]. OTS.

Data on the effects of nuclear fuel burnup on dissolution rates and U losses of a few fuel types are summarized. Burnup to the 40% level produced very little effect on the rate of solution of stainless steel- UO_2 fuel elements in solutions of the Darex type. Beyond passivation, burnup to the 250 Mwd/T level did not produce a large effect on the rate of decladding nor on the U losses in the Sulfex process. Burnup to the 15% or 4300 Mwd/T level produced little or no effect on the rate of decladding, U losses, or Pu losses in the Zircex process. Two other effects, air oxidation of irradiated UO_2 and prolonged contact of this oxide with Sulfex solutions in the absence of actively dissolving stainless steel appeared to be much more serious sources of loss of U. (auth)

19018 CF-60-3-11

Oak Ridge National Lab., Tenn.

HOT CELL DEMONSTRATION OF THE FUSED SALT VOLATILITY PROCESS. G. I. Cathers, R. L. Jolley, and E. C. Moncrief. June 3, 1960. 21p. OTS.

A series of laboratory scale tests showed that high-burnup U-Zr fuel can be successfully decontaminated by the Fused Salt Volatility process. Decontamination factors were of the order of 10^6 to 10^9 . The UF_6 product contained significant quantities of chemical impurities. (auth)

19019 CF-60-3-22

Oak Ridge National Lab., Tenn.

SEPARATION OF TRANSPLUTONIUM AND RARE EARTH ELEMENTS BY LIQUID-LIQUID EXTRACTION. R. D. Baybarz and R. E. Leuze. June 6, 1960. 14p. Contract [W-7405-eng-26]. OTS.

A solvent extraction process for separating americium and curium from major portions of rare earths was developed. Rare earth elements are extracted from 10 M LiCl solutions (with HCl varying from 0.5 to 1.0 M) into 0.5 M mono-2-ethylhexyl orthophosphoric acid in xylene carrier.

The americium and curium remain in the lithium chloride solution. Americium is separated from all rare earths and curium from all rare earths except lanthanum by counter-current extraction. The extractability of the rare earths, americium, and curium in 10 M LiCl is affected by the HCl feed, and rare earth concentrations in the feed, the organic extractant concentration, and the nature of the diluent.

(auth)

19020 CF-60-3-23

Oak Ridge National Lab., Tenn.

ANION EXCHANGE SEPARATION OF TRIVALENT ACTINIDES AND LANTHANIDES. M. H. Loyd and R. E. Leuze. June 3, 1960. 12p. Contract [W-7405-eng-26]. OTS.

A process for separating americium and curium from rare earths by anion exchange based on selective chloride complexing was developed and tested on a laboratory scale. The separation is accomplished by sorption of americium, curium, and rare earths on Dowex 1-10X resin from a solution of 8 M LiNO₃ followed by selective elution of rare earths with 10 M LiCl and americium-curium elution with 1 M LiCl. In a laboratory demonstration of this process, greater than 99.5% of americium tracer containing no detectable amounts of rare earths was recovered. (auth)

19021 CF-60-5-114

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C PROGRESS REPORT FOR APRIL-MAY 1960. K. B. Brown. July 12, 1960. 49p. OTS.

An economical process was successfully demonstrated in bench-scale continuous equipment for stripping U from amines with ammonium carbonate solution. A continuous countercurrent mixer-settler extraction system was set up for further testing of the process for recovery of Te, Np, and U by tertiary amine extraction from UF₆ transfer cylinder was solutions. The effect of Purex aqueous feed adjustment procedures on Pu extraction by 1 M di-*sec*-butyl phenylphosphonate (DSBPP) was studied. Work was continued on plutonium(IV) nitrate extraction with TBP and phenylphosphonate esters. The response of Ru¹⁰⁶ extraction to variations in the treatment of TBP-Amsco 125-82 solvent was tested. Two solvents have shown ability to extract cesium. (For preceding period see CF-60-3-136.) (W.L.H.)

19022 HW-37682

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PROTOTYPICAL TESTING OF PUREX PLANT AGITATOR AF-15. J. Dunn. June 16, 1955. 6p. Contract AT(45-1)-1350. OTS.

A typical Purex plant canyon agitator was operated in a tank, agitating liquid at various levels and temperatures for 4,723 hrs. It was concluded that if the lower turbine of the agitator is totally submerged, the agitator should perform in excess of 5,000 hrs without failure. Extended operation with the liquid level lower than one inch above the bottom turbine should be avoided at all times. (J.R.D.)

19023 HW-62505

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE SEPARATION OF CERIUM FROM THE TRIVALENT RARE EARTHS USING HYDROGEN PEROXIDE AND SODIUM ACETATE. E. J. Wheelwright and N. C. Howard. May 18, 1960. 18p. Contract AT(45-1)-1350. OTS.

Cerium was completely precipitated (>99%) as a cerium(IV) peroxyacetate from a nitrate solution containing cerium, yttrium, and other trivalent rare earths with only 5 to 15% of the trivalent rare earths carrying

on the cerium precipitate. The process is accomplished by the addition of a buffered hydrogen peroxide-sodium acetate solution to the rare earth nitrate feed solution at 25°C, equilibration for three hours at 45 to 55°C, filtration or centrifugation of the precipitate, washing of the precipitate, and dissolution of the precipitate in warm nitric acid. The contamination of the cerium precipitate by the trivalent rare earths can be reduced to less than 1% of the trivalent rare earth content of the initial feed solution by a reprecipitation. The recovery of cerium and the degree of separation from the other rare earths depended upon balancing the pH of the peroxide-acetate solution against the pH of the rare earth feed solution. This can be accomplished within reasonably broad limits. The limits are sufficiently broad enough to carry out the process in the Purex plant head-end equipment with exercise of reasonable care. (auth)

19024 HW-62537

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DAREX PILOT PLANT STUDIES. J. J. Shefcik. Oct. 29, 1959. 20p. Contract AT(45-1)-1350. OTS.

The Darex process is designed to convert stainless steel jacketed fuel elements into solvent extraction feed. The potential reprocessing of various stainless-steel-clad-low-enrichment fuels suggested a versatile batch flowsheet. Findings from pilot plant studies of the batch process are summarized. The method used to remove excess chlorine from the process is explained. (B.O.G.)

19025 ORO-271

Kentucky. Univ., Lexington.

A STUDY OF THE EXTRACTION OF THE RARE EARTHS BY ACETYLACETONE (thesis). Willard Bruce Brown. 1959. 71p. Contract AT(40-1)-2124. OTS.

Acetylacetone extracts the lanthanons from aqueous solution at pH values between 4 and 6. The solubility and extractability of the rare earth acetylacetonates vary with the ionic radii of the central metal ion. Extractability is enhanced by the increase in acidity of the rare earth ions. Separations of the rare earths by this system are based on variations in solubility and in the partition coefficients of the rare earth acetylacetonates. Differences in the pH values where these chelates extract promote only fractional separation. The rare earths above dysprosium are readily separated by counter-current extraction in a thirty-tube Craig apparatus. Yttrium, dysprosium, and terbium show little separation by countercurrent extraction after twenty-nine transfers. However, the lanthanons below terbium show some separation by counter-current extraction. The extraction data for the rare earth acetylacetonates were used to calculate the formation constants of these chelates. (auth)

19026 TID-6150

Western State Coll. of Colorado, Gunnison.

SOLVENT EXTRACTION STUDIES. An Annual Report. C. Gerald Warren. May 1960. 27p. Contract AT(11-1)-749. OTS.

Steric relationships were incorporated into various organophosphorus compounds with the purpose of testing the effect of partial steric hindrance on the ability of these compounds to separate the lanthanide and related elements in a liquid-liquid extraction system. The difference in the distribution of radioactive scandium and yttrium at various concentrations of the reagents involved in the extraction was used to establish the chemical reaction of the extraction process. Procedures for the synthesis of the organophosphorus compounds and their intermediates were also investigated. (auth)

19027 UCRL-6019-T

California. Univ., Livermore. Lawrence Radiation Lab. ELECTRON ACCELERATORS REQUIRING HIGH PEAK POWER PULSE MODULATORS. Vernon L. Smith. June 7, 1960. 4p. Contract [W-7405-eng-48.] OTS.

Descriptions and operation of high peak power pulse modulators for a 5-Mev, 200-amp electron accelerator are given. (C.J.G.)

19028

THE USE OF ETHYLENEDIAMINETETRA-ACETIC ACID IN THE SEPARATION OF RADIOACTIVE BARIUM AND STRONTIUM. H. A. C. Montgomery (Water Pollution Research Lab., Stevenage, Herts, Eng.). *Analyst* **85**, 524-6 (1960) July.

A method for the separation of radioactive barium and strontium was developed for application to the precipitate of mixed nitrates customarily obtained with 75% HNO_3 . The difference between the solubility products of barium and strontium chromates was reinforced by the different stabilities of the complexes formed by these elements with ethylenediaminetetraacetic acid (EDTA). A high yield of barium chromate, almost free from strontium, was obtained by adding an excess of chromate ions to an ammoniacal solution of the complexes of the metals with EDTA. Strontium was then recovered as sulfate by displacement with copper. (M.C.G.)

19029

EXTRACTION OF URANIUM FROM SOLUTIONS AND SLIMES. B. N. Laskorin, A. P. Zefirov, and D. I. Skorovarov. *Atomnaya Energ.* **8**, 519-29 (1960) June. (In Russian)

Data on uranium extraction from sulfuric, nitric, hydrochloric, and phosphoric acid solutions and slimes are presented. Ethers of carbonic acid, phosphoric acid, and phosphinic acid, as well as liquid cations and anions, are analyzed as extraction agents for use under industrial conditions. The scheme of uranium extraction from dense ore slimes is included. (tr-auth)

19030

ISOLATION OF Pu^{239} FROM URANIUM OXIDE IRRADIATED JRR-1. Kenjiro Kimura, Tomitaro Ishimori, Keiji Naito, Hirokazu Umezawa, and Kenju Watanabe (Japan Atomic Energy Research Inst., Tokyo). *J. Atomic Energy Soc. Japan* **2**, 328-36 (1960) June. (In Japanese)

Natural or depleted uranium targets were irradiated in JRR-1 with 10^{11} n/sec·cm² flux for 30 to 60 hr. After setting the irradiated target aside for a few months in a hot-cave, Pu^{239} was isolated by TBP solvent extraction from the bulk of uranium and fission products and then purified by anion-exchange. It was found that Pu^{239} thus obtained was not contaminated with uranium and Po^{210} . However, it contained a small amount of β and γ activity of about 30 days half-life. (auth)

19031

ANOMALOUS SOLVENT EXTRACTION EQUILIBRIA DUE TO VIOLENCE OF AGITATION. Kenneth A. Allen and W. J. McDowell (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **64**, 877-80 (1960) July.

It is shown that previously anomalous dependences of uranium extraction coefficients on tri-n-octylamine sulfate and di-n-decylamine sulfate concentrations in benzene are due to metastable conditions induced by the vigorous agitation customarily employed in separatory funnel equilibrations. Nearly theoretically ideal results are obtained on slow equilibration in special cells which limit the liquid-liquid interfacial area markedly, and prevent interfacial

turbulence completely. An explanation is proposed, based on adsorption of the critical components at the much larger interfacial area generated during vigorous agitation, which accounts for the long-term persistence of the anomalous effects after phase clarification. It is believed that this is the first observation of such effects in liquid-liquid extraction systems. (auth)

19032

IODINE—ITS REMOVAL FROM GAS STREAMS. D. Geldart (Bradford Inst. of Tech., Eng.). *Nuclear Eng.* **5**, 217-20 (1960) May.

I^{135} removal from reactors is important because it is a health hazard and a precursor of Xe^{135} . Since iodine is a readily condensable vapor, its removal presents problems, e.g., aerosol or dust particles in air will absorb iodine vapor. Therefore, the choice of a suitable iodine treatment system must be made bearing in mind the possible physical forms in which iodine may be present. Liquid and solid absorbers for the removal of iodine from gas streams and their limitations are discussed; water, caustic soda solution, metals, silver compounds, activated carbon, graphite, and molecular sieves are included, with emphasis on activated carbon. The factors involved in the choice of an iodine removal system are illustrated in the problem of an in-pile testing rig under various fault conditions, e.g., coolant and fuel element failure. The system finally chosen is one with an activated carbon bed, but it is emphasized that no one iodine removal system can be used for all problems. (D.L.C.)

19033

XENON-KRYPTON SEPARATION BY GAS CHROMATOGRAPHY. R. C. Koch and G. L. Grandy (Nuclear Science and Engineering Corp., Pittsburgh). *Nucleonics* **18**, No. 7, 76; 78; 80 (1960) July.

A series of tracer experiments using Kr^{85} and Xe^{133} was performed in order to investigate the feasibility of separating Kr and Xe by gas chromatography. The columns used were activated charcoal and the carrier gas, helium; both static and dynamic methods of charging the sample were used. The results at 70 and 32°F indicated clear-cut separation of Kr and Xe and that static charging was best for quantitative analysis. (D.L.C.)

19034

THE SORPTION OF URANIUM FROM CARBONATE SOLUTIONS ON STRONGLY BASIC ANION EXCHANGER.

Wincenty Korpak and Kazimierz Majchrzak (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). *Nukleonika* **5**, 55-62 (1960). (In Polish)

It is confirmed that the anion-exchange resin SM-x5 is capable of uranium sorption from carbonate solutions. The distribution coefficient is a function of uranium concentration ($D = 1/k_1 + k_2[U]_R$), carbonate concentration ($D = k/[\text{CO}_3]_R$), pH, and concentration of other anions in the solution. On the basis of affinities of various anions to the resin, the nitrate and chloride solutions are chosen as eluants. It is corroborated that the ion exchange follows the mass action law. The equilibrium constant is calculated to be 304 ± 29 . (auth)

19035

QUANTITATIVE SEPARATION OF INDIUM IN MATERIALS CONTAINING TIN. I. S. Levin, R. A. Polovinkina, and O. M. Polunina (Tin Research Inst. of West Siberian Branch, Academy of Sciences, USSR). *Zavodskaya Lab.* **26**, 148-9 (1960). (In Russian)

It was noted during the determination of In in cassiterite, which involves melting the specimen with Na_2O_2 and leach-

ing the Sn, In, and Al, that the In values were much lower than those obtained by spectrographic analysis. This was ascribed to an incomplete leaching of In by water. Tests were made with material consisting of dust collected on filters and containing up to 0.4% In. In-114 was used as a tagged atom for determining the precision of the method. Results indicated that the original method yields an incomplete separation during the leaching process, —even addition of Fe oxide as a coprecipitant did not result in complete separation of the indium. However, addition of tenfold amounts of MgO insured a nearly complete separation of the element. Although the exact mechanism of the process is not yet known, it is established that during the leaching process $\text{In}(\text{OH})_3$ and not MgIn_2O_4 is formed. (TTT)

19036

ALKYLPHOSPHONATES, DIPHOSPHONATES AND PHOSPHINE OXIDES AS EXTRACTANTS. K. A. Petrov, V. B. Shevchenko, V. G. Timoshev, P. A. Malyaev, A. V. Fokin, A. V. Rodionov, V. V. Balandina, A. V. El'kina, Z. I. Nagnibeda, and A. A. Volkova. *Zhur. Neorg. Khim.* **5**, 498-502(1960) Feb. (In Russian)

The distribution coefficients of uranium, plutonium(IV), $\text{Zr}^{95} + \text{Nb}^{95}$, and Nb^{95} were obtained with tributylphosphate, various alkylphosphonates, phosphine oxides, and diphosphonates. The initial solution contained 50 g/l of uranium, 1.0 g/l of plutonium(IV), and 1.0 curie/l $\text{Zr}^{95} + \text{Nb}^{95}$. Determinations were made at 0.5, 1.0, and 2.0 N HNO_3 with a volume ratio of organic to aqueous = 2 and a temperature = $20 \pm 1^\circ\text{C}$. The alkylphosphonates and phosphine oxide are better extractants for uranium and plutonium than tributylphosphate. The distribution coefficients for zirconium and niobium are low. The extraction of uranium is enhanced on increasing the number of carbon atoms in the alkoxy side chain to 8. The introduction of a phenyl group leads to a decrease in the extraction of uranium. Ammonium carbonate was more satisfactory than acetic acid in back-extracting uranium from diisooamylphosphonate. The phosphine oxides are superior to the alkylphosphonates which in turn are stronger extractants than n-tributylphosphate. (TTT)

19037

COPRECIPITATION OF SELENIUM AND TELLURIUM WITH METALLIC HYDROXIDES. V. I. Plotnikov (All Union Mining-Metallurgical Scientific Research Inst. of Non-Ferrous Metals). *Zhur. Neorg. Khim.* **5**, 731-7(1960) Mar. (In Russian)

An attempt is made to explain the effect of the nature of the hydroxide carrier used to coprecipitate small amounts of Se and Te. Ammonia was added drop by drop to an equivalent amount of metal nitrate salt in 0.5N NH_4NO_3 solution, until precipitation of the hydroxide is complete. Se^{75} and Te^{127} were used as tracers. The pH was measured to ± 0.05 pH units by a platinum-hydrogen electrode. The differences in chemical behavior between Se and Te become more manifest at high pH. The results show that the carrying of Se increases with an increase in ionic radius of the metal which is precipitated as the hydroxide in the order $\text{Al} \rightarrow \text{Ti} \rightarrow \text{Bi} \rightarrow \text{Pb}$. The higher the valence of the metallic carrier ion the greater the carrying of Se for two metals with the same ionic radius. Ceri hydroxide has been found to be the most suitable carrier for Se(IV), but Ce, like all the other metallic hydroxides, does not carry Se(VI). A series of experiments showed that $\text{Fe}(\text{OH})_3$ carries both Te(IV) and Te(VI). A new method of separating Te and Se was developed on the basis that Te(VI) is carried on $\text{Fe}(\text{OH})_3$ but Se(VI) is not. A series of comparative experiments with beryllium hy-

droxide carrier at a pH of 7.5 to 9.5 showed that the carrying falls off in the following order: $\text{Te}(\text{VI}) \rightarrow \text{Te}(\text{IV}) \rightarrow \text{Se}(\text{IV}) \rightarrow \text{Se}(\text{VI})$. Carrying decreases with increasing valence for Se, but increases with increasing valence for Te. The coprecipitation of Se and Te depends on the nature of the anion in solution and increases with a decrease in the dissociation of the corresponding acids. Preformed precipitates do not carry Se or Te as well as direct precipitation of the metallic hydroxide in the presence of Se or Te. (TTT)

19038

EXTRACTION OF ACIDS BY ORGANIC SOLVENTS. A. A. Grinberg and G. S. Lozhkina (Lomonosov Moscow State Univ.). *Zhur. Neorg. Khim.* **5**, 738-44(1960) Mar. (In Russian)

The distribution coefficients of HNO_3 , HClO_4 , HCl , and HBr between water and the oxygen-containing solvents ethyl ether, isoamyl alcohol, and isoamyl acetate and between water and the non-oxygen-containing solvents benzene and carbon tetrachloride were found to decrease with decreasing concentration of acid. The explanation lies in the more complete ionization of the acid on dilution. Isoamyl alcohol was the most efficient extractant. HClO_4 and HNO_3 extracted better than HCl and HBr . A salting agent such as NaNO_3 or $\text{Ca}(\text{NO}_3)_2$ salts out nitric acid from the aqueous phase into isoamyl alcohol. However, an increasing acid concentration in the aqueous "salts out" the salting agent so that the saturated aqueous phase holds less salting agent. Hence, the distribution coefficient (K_D) of the acid increases with decreasing acid concentration in the aqueous saturated with a salting agent since the aqueous phase can hold more salting agent. With decreasing concentration of salting agent at constant acidity, the K_D falls off. (TTT)

19039

THE EXTRACTION OF URANIUM FROM HCl SOLUTIONS BY TRIBUTYLPHOSPHATE (TBP). V. M. Vdovenko, A. A. Lipovskii, and S. A. Nikitina. *Zhur. Neorg. Khim.* **5**, 935-40(1960) Apr. (In Russian)

From HCl solutions it is shown by a study of its adsorption spectra that TBP can extract uranium in the form of a chloride complex $\text{H}[\text{UO}_2\text{Cl}_3]$ whose content in the organic phase increases with increasing HCl concentration in the initial aqueous phase. The addition of water to a solution of the trichlorocomplex in dry TBP showed changes in the absorption spectra that indicated a break-up of the trichlorocomplex. Distribution coefficients for uranium from 1.02, 6.75, and 10.7N HCl were determined as a function of the concentration of TBP in benzene with the use of U^{233} tracer. The results showed that uranyl chloride is extracted as $\text{UO}_2\text{Cl}_2 \cdot 2\text{TBP}$. The trichlorocomplex could be detected only at significant concentrations of TBP in benzene (50 to 60%) from 6.75 and 10.7N HCl; hence, it was not possible to determine the number of TBP molecules associated with the trichlorocomplex due to the deficiency of HCl in the organic phase at low TBP concentrations in benzene. The complex $\text{HCl} \cdot 2\text{TBP}$ was shown to exist in the organic phase with a 6.25N HCl aqueous phase. The stability of the trichlorocomplex in TBP increases at higher HCl concentration, while water extracted by the organic phase causes a break-up of this complex. In this system there is competition for TBP between UO_2Cl_2 and HCl on the one hand, and a competition for uranyl ion between TBP, water, and chloride ions on the other hand. (TTT)

19040

EXTRACTION OF MIXED HEAVY METAL FERROCYNIDES FROM HYDROSOLS AND SLURRIES. V. V. Push-

karev, L. D. Skrylev, and V. F. Bagretsov (Kirov Urals Polytechnic Inst., USSR). *Zhur. Priklad. Khim.* **33**, 59-61 (1960) Jan. (In Russian)

The first of a series on the application of the foaming properties of gelatin in concentrating radioactive cesium isotopes is presented. A slurry of a mixed heavy metal ferrocyanide was formed by adding a solution of a heavy metal salt to a dilute $K_4Fe(CN)_6$ solution. Then, a variable amount of a 1% gelatin solution was added to the slurry, and the mixture was foamed by forcing air at 1.5 atm through a glass fritted disk and the mixture. The gelatin solution was freshly prepared. The foam was collected in a separate vessel and the loss in volume of the starting solution was noted. Extraction of the ferrocyanide from the slurry was complete after foaming 3 to 4 minutes. The ferrocyanides studied were $K_2Mn[Fe(CN)_6]$, $K_4Co_{10}[Fe(CN)_6]_6$, $K_4Ni_4[Fe(CN)_6]_3$, $K_2Zn_3[Fe(CN)_6]_2$, $K_2Cu_3[Fe(CN)_6]_2$, and $Pb_2[Fe(CN)_6]$. The least amount of gelatin was used to separate the lead and manganese ferrocyanides. The copper and cobalt compounds required the same amount of gelatin. The most stable, voluminous, and wettest foams were formed with zinc and nickel ferrocyanides. The limiting amounts of ferrocyanide extracted were 1000 to 3000 mg/liter, because of the rapid increase in volume and wetness of foam at higher concentrations. The amount of gelatin decreases by a factor of six on increasing the pH of the starting solution from 2 to 5. Thus, the amount of 1% gelatin solution required to foam over 50 mg of $K_4Ni_4[Fe(CN)_6]_3$ is 9.0 ml at pH 2.0, 8.0 ml at pH 3.0, 3.0 ml at pH 4.0, and 1.5 ml at pH 5.0. The foam extraction of ferrocyanides proceeds most favorably with the smallest expenditure of gelatin in weak acid or neutral solution. The volume and wetness of the foam increases, and the stability and extractive ability of the foam decreases in a more acidic or basic media. It is concluded that the heavy metal ferrocyanides acts as stabilizers for the gelatin foam. (TTT)

19041

EXTRACTION OF RADIOACTIVE CESIUM BY MIXED HEAVY METAL FERROCYANIDES. V. V. Pushkarev, L. D. Skrylev, and V. F. Bagretsov (Kirov Urals Polytechnic Inst., USSR). *Zhur. Priklad. Khim.* **33**, 81-5 (1960) Jan. (In Russian)

The mixed ferrocyanides $K_2Mn[Fe(CN)_6]$, $Pb_2[Fe(CN)_6]$, $K_4Co_{10}[Fe(CN)_6]_6$, $K_4Ni_4[Fe(CN)_6]_3$, $K_2Zn_3[Fe(CN)_6]_2$, and $K_2Cu_3[Fe(CN)_6]_2$, were used as carriers (100 mg/l) to adsorb Cs^{134} (sp. act. = 5 to 10 mc/l) from aqueous solution. Centrifugation of the slurry for 10 minutes at 3000 rev/min did not result in complete separation of the precipitate from the solution, particularly for pH values greater than 5. A 50% excess of the heavy metal salt did not affect the carrying of cesium and improved the centrifugation properties of the precipitate. The addition of a small amount of 1% gelatin solution to the ferrocyanide slurry and creation of a foam by bubbling air through the solution was shown to be a successful method of concentrating radioactive solutions of cesium. The results show that 60 mg/l of ferrocyanide carrier is sufficient for maximum extraction of cesium. The amount of solution carried over by the foam in this process does not exceed 1.0 to 4.0% of the volume of the starting solution. Three successive extractions of cesium by foaming over a ferrocyanide carrier, each time from the same solution, showed that 98.84% of the cesium was found in the foam the first time, 89.07% the second time and 81.98% the third time with an over-all yield of 99.98%. An increase in concentration of $NaNO_3$, Na_2SO_4 , $NaCl$, CH_3COONa , and CH_3COOH in the aqueous solution led to a sharp increase in the volume of solution carried over by the foam. The possibility of ex-

tracting Cs^{134} from aqueous solution by adsorption on a heavy metal ferrocyanide precipitate with a subsequent foam separation of the precipitate by addition of gelatin was established in principle. (TTT)

19042

THE EXTRACTION OF METALS BY ACID ALKYL PHOSPHATES. A. S. Chernyak and M. L. Navtanovich (Irkutsk State Scientific-Research Inst. of Rare Metals, USSR). *Zhur. Priklad. Khim.* **33**, 85-9 (1960) Jan. (In Russian)

Acid alkyl phosphates are ordinarily prepared by reacting an alcohol with phosphorus pentoxide. It may be presumed that a mixture of the acid ethers of phosphoric acid (mono and diethers), RH_2PO_4 and R_2HPO_4 , and the neutral ether of phosphoric acid, R_3PO_4 , can be produced, where R is the organic radical. The composition of the products of the reaction were determined for the starting alcohols n-butyl and isoamyl by extracting a kerosene or benzene solution of the mixed alkyl ethers with water and then with a 5% Na_2CO_3 solution. The mono ether was determined by titrating with caustic to a methyl orange end-point and the diether by titrating to a phenolphthalein end-point. This procedure is similar to that used to determine the purity of various acid phosphate salts. Phosphate was determined by the use of standard molybdate after oxidation of the organic compound with a mixture of sulfuric and nitric acids. The neutral ether remains in the kerosene or benzene layer and was analyzed for but none could be found. It was found that with the usual method of synthesis (two moles of alcohol per mole of P_2O_5) the diether (87.8 to 90.5%) is primarily produced. The amount of mono ether formed increases from 12.3 to 60.7% on increasing the mol ratio of alcohol to P_2O_5 from 2 to 6. Tracer experiments with phosphoric and sulfuric acids tagged with P^{32} and S^{35} showed that these acids are not extracted by acid alkyl phosphates. Solutions containing various cations (Fe^{3+} , Ti^{4+} , Zr^{4+} , and Nb^{5+}) and anions (Cl^- , NO_3^- , SO_4^{2-} , PO_4^{3-}) were extracted with 10% alkylphosphate solution in kerosene. The metal cation was extracted but not the anion. Thus the acid alkyl phosphates can be used to extract metal from strongly acid as well as weakly acid solutions. (TTT)

19043

RECOVERY OF RHENIUM FROM TUNGSTEN-RHENIUM ALLOYS. A. I. Lazarev (Akmolinskii Agricultural Inst., USSR). *Zhur. Priklad. Khim.* **33**, 468-9 (1960) Feb. (In Russian)

A 20 g sample of W-Re alloy is heated in a water bath with 50 to 100 ml of 30% H_2O_2 . Fresh portions of 30% H_2O_2 must be added from time to time because of the catalytic decomposition on the surface of the alloy. Dissolution of the alloy is more rapid with a mixture of 20 ml of HNO_3 and 50 ml of 30% H_2O_2 . Further heating decomposes the excess H_2O_2 and converts the pertungstic acid to tungstic acid, which separates out as a precipitate. Rhenium is recovered from the filtrate as ammonium or potassium perrhenate. It is also possible to neutralize the acid solution with a 30% excess of $Ca(OH)_2$ and precipitate tungsten as $CaWO_4$. The filtrate containing Ca^{2+} and ReO_4^- is passed through the hydrogen form of a cation exchanger in order to separate calcium from perrhenate. The dilute column effluent of perrhenic acid is neutralized with KOH or NH_4OH and evaporated to dryness under an infrared lamp in order to recover the rhenium. The recovery of rhenium is >99% by both methods. (TTT)

19044

DISTRIBUTION OF RARE EARTH ELEMENTS BETWEEN THE SOLID AND LIQUID PHASES DURING THE CRYSTALLIZATION OF DOUBLE SULFATES. Ya. G. Gorosh-

chenko, V. I. Belokoskov, and I. G. Babkin. *Zhur. Priklad. Khim.* 33, 803-8(1960) Apr. (In Russian)

The distribution of various rare earth elements between the solid and liquid phases during the crystallization of their double sulfates with alkali metals was investigated by means of the beta activity of their radioactive isotopes. The original mixture corresponded to the composition of the lanthanides contained in Nb-Ti-rare earth ores of economic interest from which the cerium was previously removed. It was found that the distribution coefficients of La, Pr, and Nd in the liquid phase increases with the number of the element. Crystallization of the double sulfates containing K and NH_4 by the addition of H_2SO_4 results in an enrichment of rare earths beyond Sm in the solution, while Na_2SO_4 favors the enrichment of elements beyond Eu. In the absence of sulfuric acid, $(\text{NH}_4)_2\text{SO}_4$ forms soluble compounds with the lanthanides and therefore cannot be used for concentrating the heavy lanthanides in the solution. This method might be of interest for separating small amounts of other rare earths added to La, Pm, and Nd. (TTT)

19045

FISSION PRODUCT SEPARATOR FOR LIQUID REACTOR SYSTEMS. George Vernon Hough (to Plessey Co., Ltd.). British Patent 836,047. June 1, 1960.

An apparatus is described for use in the detection of faulty fuel elements in a liquid-cooled or liquid-moderated reactor. The apparatus has individual channel selector valves which are contained within the scrubbing unit, and each selected channel pipe delivers liquid directly into the gas inside the scrubbing chamber. The fission product gases are scrubbed from the liquid. A carrier gas is used to convey the fission product gases to a conventional pre-precipitation chamber. (W.L.H.)

19046

PROCESSES OF PRODUCING AND RECOVERING URANIUM ENRICHED WITH U^{235} . (to United Kingdom Atomic Energy Authority). British Patent 836,771. June 9, 1960.

A process is described for the recovery of U from a calutron source region. The parts of the calutron source are washed with hot water. The hot water is passed through a sieve and the solid impurities are discarded. The wash water from the sieve is passed into an oxidizing zone containing H_2O_2 . The resulting oxidized solution is treated with NH_3 to precipitate ammonium diuranate and ferric and chromium hydroxides. (W.L.H.)

19047

DECONTAMINATION OF PLUTONIUM-ALUMINUM ALLOY MATERIAL. (to Atomic Energy of Canada, Ltd.). British Patent 836,916. June 9, 1960.

A method is described for decontaminating irradiated Pu-Al alloy by dissolving the alloy in a bath of molten fluoride salt of an alkali or alkaline earth metal. The salt phase is separated from the metal phase, and the salt phase is treated with Al above the melting point of the salt phase to form decontaminated Al-Pu alloy. (W.L.H.)

19048

METHOD OF OBTAINING A PLUTONIUM CONCENTRATE FROM PLUTONIUM-CONTAINING URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 836,980. June 9, 1960.

A method is described for obtaining a Pu concentrate from a Pu-containing U. The method consists of forming a melt of the U with up to 20 wt.% Sn, Ag, Au, Bi, or Cu and recovering from the melt a Pu-rich Sn, Ag, Au, Bi, or Cu phase. The U is separated from the melt either by hydrogenation or nitrogenation. (W.L.H.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

19049 AERE-ED/R-1696

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A STUDY IN DESIGN OF TRAVELLING FIELD ELECTROMAGNETIC PUMPS FOR LIQUID METALS. D. A. Watt. June 12, 1955. 50p. BIS.

A simplified theory of design of a traveling field electromagnetic pump is presented. Optimum conditions of design are deduced together with the requirement for maximum rate of pressure rise. The theory is applied to examples for Na and Pb-Bi alloy. An optimized design of d-c pump is compared with a-c designs for the latter. While acceptable efficiencies in units of convenient size were found possible for a-c traveling field pumps applied to the low density liquid metals, this type is shown to be inherently at a great disadvantage when considered for the larger power requirements of the high density, high resistivity liquid metals. This requirement was met by compact high power d-c pumps supplied either from high efficiency homopolar generators or, where space permits, from rectifier sets. Theoretical power/weight ratings for optimized designs are cited for 20 to 25 hp/ton for a FLIP unit handling Na and 75 to 150 hp/ton for a d-c pump for Pb-Bi alloy. The estimated over-all efficiency is near 40% in each case, including the d-c source losses. Numerous curves of the design parameters for traveling field pumps for a wide range of wall/liquid conductivity ratio are contained. (auth)

19050 AFOSR-TR-58-14

Litton Industries. Research Labs., Beverly Hills, Calif. THE INHABITED HIGH VACUUM LABORATORY. Final Report. Jan. 8, 1958. 101p. Contract AF18(600)-1498. (AD-148105).

A prototype laboratory which provides the means of human occupancy, observation, and manual operations in an environment maintained at an absolute pressure of the order of one billionth of an atmosphere is described. The laboratory consists of a vacuum chamber eight feet in diameter and fifteen feet long which is evacuated and maintained at extremely low pressure by pumping equipment whose performance is given. Human occupancy of the laboratory chamber in the almost total absence of air was made practical by providing the occupant with a unique pressure suit which is supplied with oxygen for breathing and ventilation and allows for manipulations requiring considerable dexterity. The instrumentation, controls, and auxiliaries which supplement the laboratory chamber make the laboratory a complete facility for experimentation and study under conditions which closely simulate outer space. (W.L.H.)

19051 AFOSR-TR-60-72

Westinghouse Electric Corp. Research Lab., Pittsburgh. ELECTRICAL CLEANUP OF GASES. Research Report 403FD428-R5. Final Report [for] March 15, 1959-May 14, 1950. R. E. Fox and J. S. Knoll. May 14, 1960. 27p. Contract AF49(638)-591.

The spontaneous re-emission of gases from surfaces which are not under bombardment by other ions, high energy neutrals, or photons was investigated. A phenomenological theory was derived to explain the short term re-emission processes observed in ion pumping of noble gases into various surfaces. In deriving the theory, it

was assumed that the re-emission function was temperature independent. From re-emission data taken at long times (minutes) after pumping ceased, it was concluded that the short term re-emission (occurring during pumping) was of sufficient magnitude to modify the apparent pumpdown data by an appreciable amount. The long term re-emission data were found to obey a $1/t$ dependence, where t is the time after pumping ceased. It was not possible to determine re-emission as a function of time for intervals less than about one minute. The effects of anode temperatures on the pumpdown and re-emission rates were investigated. Helium pumpdown into molybdenum and helium re-emission from molybdenum and nickel were investigated. (C.J.G.)

19052 APEX-560

General Electric Co. General Engineering Lab., Schenectady, N. Y.

EVALUATION OF ROLLING CONTACTS IN THE RANGE OF 550° TO 1000°F. S. F. Murray and P. Lewis. Feb. 7, 1958. 93p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

Previously issued as 58-GL-50.

An experimental study was made on rolling contact bearings in the temperature range of 550 to 1000°F. Variables such as material composition, hardness, and operating conditions were investigated in a rolling test stand. Ball bearing tests were run to determine the effect of design parameters, bearing materials, lubricants, and operating conditions. (auth)

19053 CERN-60-9

European Organization for Nuclear Research, Geneva. THE CERN PNEUMATIC TRANSPORT SYSTEM. H. Horisberger. Mar. 24, 1960. 10p.

A CERN system for moving heavy equipment at low speeds on smooth surfaces is described. Static air pressure retained by seals is used to lift the equipment one or two millimeters above the floor. In this way, it is possible to reduce the friction coefficient for sliding by a factor of 20. Platform construction and uses are discussed. (J.R.D.)

19054 LMSD-288139(Vol. II)(Paper 7)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STRESSES IN SPHERICAL PRESSURE VESSELS. O. Hoffman. Paper 7 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 22p.

The relationships for stresses and deformations in thin-walled spherical pressure vessels subjected to uniform internal pressure are summarized. Some applications to practical design problems are shown, such as discontinuity stresses due to the presence of an elastic reinforcing ring, and those occurring at welded joints because of manufacturing inaccuracies. (auth)

19055 NAA-SR-Memo-2830

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SINTERED METAL FILTERS FOR SODIUM COOLANT SYSTEMS. J. S. McDonald. June 27, 1958. 10p. OTS.

Equations which express the relations between the pressure drop, pore size, flow rate, and filter thickness for sodium flowing through sintered metal filters were derived. (C.J.G.)

19056 NAA-SR-Memo-2898

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EVALUATION OF PREFABRICATED PIPE INSULATION-HEATER SECTIONS. C. J. Baroczy. July 15, 1958. 12p. OTS.

The thermal and physical performance characteristics of prefabricated pipe insulation-heater sections as applied to preheating sodium systems were evaluated. (C.J.G.)

19057 NAA-SR-Memo-3961

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMAL CYCLING AND LEAKAGE TESTS OF 12-INCH SODIUM VALVES. C. J. Baroczy. Sept. 23, 1959. 30p. OTS.

Tests of 12-in. sodium valves for use in the Hallam nuclear power facility are described. The valves were thermally cycled at 680 to 1100°F in a sodium loop and periodically examined for across-the-seat leakage. Results are tabulated. A discussion of testing procedure and recommendations is included. (J.R.D.)

19058 NAA-SR-Memo-3974

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DYNAMIC ANALYSIS OF THE SUPERHEATER. J. W. Crowe. June 9, 1959. 14p. OTS.

An analysis of the dynamic performance of the superheater for use in the advanced SGR is given. The transfer function of the superheater, which defines the relations between the outlet steam temperature and inlet sodium temperature variation, was determined. The experimentally determined transfer function is compared with a similar transfer function determined analytically from a single-node model. (J.R.D.)

19059 NAA-SR-Memo-4682

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

TEST OF A 24-INCH DIAMETER MODEL OF THE HNPFCERROBEND SEAL. B. W. Admire. Nov. 21, 1959. 10p. OTS.

The top shield of the Hallam Power Reactor is sealed against leakage of helium cover gas by Cerrobend alloy (50% Bi, 27% Pb, 13% Sn, and 10% Cd). Tests performed on a 24-in.-diam. model of the seal with the sealing surfaces tinned with 50-50 solder resulted in leak rates of 0.113 cc/min/lin. ft. with a 0.25 psig differential pressure and 50.4 cc/min/lin. ft. at 50 psig differential pressure. A tinning process involving both 50-50 solder and a coating of Cerrobend resulted in a leak-tight seal. The seal remained tight through melt and freeze tests. (C.J.G.)

19060 NAA-SR-Memo-4772

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

TESTS OF AN-TYPE TUBE COUPLINGS. C. Sutherland. Dec. 18, 1959. 8p. OTS.

Tests were conducted to determine the suitability of the AN-type flared tube couplings for use at 1500-psi stress level service in high-temperature sodium systems. Results indicate that such units are not suitable for use in these systems. (J.R.D.)

19061 NAA-SR-Memo-5250

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

TEST OF PROTOTYPE HNPFLARGE VALUE REMOTE OPERATOR. W. F. Marten. May 3, 1960. 13p. OTS.

Performance tests were conducted on a prototype Hallam Power Reactor large valve remote operator. The stem valve moved 0.893 and 0.827 in./psi for lower and upper half of valve travel, respectively. Variations in stem position of 0.175 in. were observed for a given signal pressure

with an identical calibration procedure. Between 0.34 and 0.44 in. of lost motion was detected. (C.J.G.)

19062 NP-8795

Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.

SOME DEVELOPMENTS IN HIGH-PRESSURE TECHNIQUE. Technical Report 151. P. W. Forsbergh, Jr. June 1960. 40p. Contract Nonr-1841(10).

Developments in high-pressure techniques as applied to research problems are reviewed. The limits imposed on high-pressure equipment by metals, effects of temperature and gases, and applications are discussed. Descriptions of various systems are given. Methods of making various types of seals are discussed. (C.J.G.)

19063 NP-8805

Naval Civil Engineering Lab., Port Hueneme, Calif. DESIGN CHARTS FOR R/C BEAMS SUBJECTED TO BLAST LOADS. Technical Report 069. Final Report. J. R. Allgood and G. R. Swihart. May 11, 1960. 144p.

An ultimate load theory was combined with an idealized dynamic theory to develop a set of design charts for reinforced concrete beams. The behavior of beams under blast loading is reviewed. A procedure for the treatment of shear and bond is presented. Design curves are given and their limitations are discussed. (auth)

19064 NP-8812

Kidde (Walter) and Co., Inc., Belleville, N. J. OIL COMBUSTION PHENOMENA IN HIGH PRESSURE AIR SYSTEMS. W. M. Weibel. Apr. 1952. 25p. (R-831).

An investigation of the combustion potentialities of various oils and greases used in pneumatic systems when charged with high-pressure air is reported. Optimum conditions for combustion were studied, and methods of reducing or eliminating the combustion hazard are discussed. (J.R.D.)

19065 PWAC-299

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn. PERFORMANCE TESTS OF THE AIR TURBINE FOR THE PRATT AND WHITNEY AIRCRAFT LIQUID METAL TURBOPUMP, TP-1. J. S. Murphy and J. Carta. June 24, 1960. 21p. Contract AF33(600)-41233.

Performance tests of the air turbine drive for liquid metal turbopumps of the type TP-1 are reported. It was determined that this type turbopump operating at 1800 rpm and 3000 gpm of 1050°F NaK requires 5.6 lb/sec of air at 1425°F. (auth)

19066 WADC-TR-59-730

Engineering Supervision Co., New York. LITERATURE SURVEY ON RESEARCH AND DEVELOPMENT OF HIGH PRESSURE TECHNOLOGY. Period covered: June 1959 to October 1959. Lawrence Berg and Harry Herman. Oct. 31, 1959. 53p. Project title: METALLIC MATERIALS. Task title: UNIQUE METALLIC MATERIALS AND PROCESSES. Contract AF33(616)-6729. OTS.

A bibliography, listing alphabetically by author the results of a survey of available literature, both foreign and domestic, classified and unclassified, in the field of high pressure technology is presented. The compiled information includes, for each article, the title, source, page number, number of pages, chemical abstract number (CA), physical abstract number (Ph.A.), and a general description of the subject matter. Co-authors of any given publication were cross-referenced. (auth)

19067 WADC-TR-59-751

Little (Arthur D.) Inc., Cambridge, Mass. HANDBOOK FOR HYDROGEN HANDLING EQUIPMENT. B. M. Bailey, D. C. Benedict, R. W. Byrnes, C. R. Campbell, A. A. Fowle, R. W. Moore, Jr., W. G. Pestalozzi, E. G. Richter, F. E. Ruccia, and C. A. Schulte. Feb. 1960. 588p. Project No. 8(78-8119). Contract AF33(616)-5641. (AD-235123). OTS.

Engineering data on the most adequate, safe, and economical procedures and equipment for liquid hydrogen storage, transfer, and ground servicing equipment are presented. Data, conclusions, and recommendations are included. (J.R.D.)

19068 WADD-TR-55-30(Pt. VIII)

Pennsylvania State Univ., University Park. Petroleum Refining Lab.

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Period covered: January through December 1959. E. Erwin Klaus, Merrell R. Fenske, and Elmer J. Tewksbury. Feb. 1, 1960. 314p. Project Nos. 3044 and 8128. Contract AF33(616)-5460.

Work carried out on continuing program to characterize behavior of various base stocks and formulations for application as hydraulic fluids and/or jet engine lubricants is described. Emphasis is placed on better understanding of capabilities of a given fluid under a variety of conditions. Mechanism proposed showing antiwear action for silicon-containing fluids with ferrous bearing surfaces. Variables designed to improve yield, efficiency, and fluid properties are discussed for low temperature solvent dewaxing. Formulations, distribution, and hardware testing of several mineral oil fluids for use at -65 to >700°F are noted. Properties are shown for used fluid from 550°F Vickers pump tests. Basic trends in thermal degradation with mineral oils are explored by determining rate of gas formation; analysis of gaseous product; and rigorous examination of liquid product. Data presented suggest different mechanisms for the gas and liquid phase reactions. Effectiveness of inhibitor combinations versus single inhibitors as antioxidants at 347, 400, and 500°F is investigated. The suitability of a small volume oxidation test for use with limited sample quantities is shown. A series of samples with 2 to 17 years storage history is being investigated for property changes due to storage. The mechanism of oxidation on or in the vicinity of hot metal surfaces was studied using the controlled atmosphere panel coker and the single-pass high temperature lube rig. (auth)

19069 WAPD-BT-18(p.13-28)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PRESSURE AND THERMAL STRESSES IN U-TUBE STEAM GENERATORS FOR NUCLEAR POWER PLANTS. H. Kraus. p.13-28 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

The high degree of structural integrity demanded in the design of steam generators requires an accurate stress analysis of the entire structure of the steam generator. A procedure for the calculation of pressure and thermal stresses in steam generators was derived and is presented in this article. This procedure forms the basis of a BOSS program which was written recently to facilitate the rapid evaluation of heat exchanger designs by use of the IBM 704 computing machine. (auth)

19070

EQUIPMENT FOR THE REMOTE OPENING OF GLASS AMPOULES CONTAINING RADIOACTIVE MATERIAL.

Ivan Bucina (Radioisotope Research Establishment, Prague). Jaderná Energie 5, 413(1959). (In Czech.)

The design and performance characteristics of a novel remote manipulator for opening glass ampoules containing radioactive materials are described. The well-known method of first heating the glass with a hot wire and then rapidly chilling the area with water or other liquid is employed for cutting the ampoule open, using a 220-4 v. fast transformer as source of current. The secondary coil can be adjusted in 2 steps from 0 to 12 v. Design of the head is unique because it not only holds the hot wire used for cutting the glass but it is provided with a syringe by means of which cold water can be squirted onto the heated areas of the glass. An extension tube contains the necessary electrical connections for the removable cutting head, while the other end of this tube is fastened to a pistol grip, being similar to a Weyland solder gun. All the electric controls are placed on this grip, while a separate rubber tube and bulb control the syringe head. Details of construction are illustrated by figures. (TTT)

19071

MECHANICAL MANIPULATOR TYPE M22. Milan Kolář and K. Rina. Jaderná energie 6, 21-2(1960). (In Czech.)

The new mechanical manipulator, constructed according to the specifications of the Soviet Type M22 unit, is suitable for handling radioactive solutions in a hot cell. It is capable of 8 different movements. The height of its telescopic movement is 550 mm; the maximum left-to-right swing 85°; the rotation of the telescope 135°; the movement of the guidance and control mechanism from the operator 115° and to the operator 60°. The load limit for the raising and placing tube and pincers is 15 kg, while the maximum load for the swinging tube is 8 kg. Additional exchangeable pincers and a series of wrenches are available for opening tubes. (TTT)

19072

AN IRRADIATION UNIT FOR THE INVESTIGATION OF SAMPLES BY PHYSICAL OR PHYSICO-CHEMICAL METHODS IN THE GAMMA RADIATION FIELD. Zbiznev Pavel Zagorski and Vladzimezh Ney (Inst. of Nuclear Research Polish Academy of Sciences, Warsaw). Nukleonika 5, 219-26(1960). (In Russian)

Trends in the construction of modern laboratory irradiation units follow the principle of versatility and the idea of performing the investigation during irradiation. Preliminary experiments carried out with two sources, 70 and 6600 c activity, respectively, showed the possibility of performing not only electrochemical, but even some optical measurements during irradiation. The unit is designed for basic research in radiation chemistry. Six cobalt-60 slugs, 300 gram-equivalent of radium, may be shifted individually from the lower part of the container to the working compartment. All six slugs, when in position, form a cage encircling the irradiated vessel. Optical pathways and access tubes enable measurements during irradiation to be performed. The principle of movable source and stationary experimental chamber enables work to be carried out with precise devices, which otherwise would be affected by the movement of the working chamber as is unfortunately the case with the Gammacell 220 irradiation unit. Proper shielding of all parts of the unit restricts to a minimum radioactivity on the surface of the device. For safety reasons, removal of the cap and access to the working chamber is possible only after shifting the cobalt slugs into the lowest positions of the spiral stainless steel storage tubes. Because the sources change position inside the irradiation unit the shielding required is rather

large and the total weight of the unit amounts to about 8000 lbs. (auth)

19073

MAXIMUM VACUUM IN CONDENSING PUMPS. E. S. Borovik, S. F. Grishin, and B. G. Lazarev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian, SSR). Pribery i Tekh. Ekspt. No. 1, 115-18(1960) Jan.-Feb. (In Russian)

The maximum vacuum of hydrogen and helium condensing pumps was tested. The construction of a hydrogen pump with maximum vacuum of $\sim 10^{-10}$ mm mercury and a helium pump with $\sim 10^{-11}$ mm mercury is discussed. The problems of maximum vacuum in diffusion pumps are also analyzed. (tr-auth)

19074

INDICATOR FOR HIGH-PRESSURE GAS COMPRESSOR. L. F. Vereshchagin and B. P. Demyashkevich (Inst. of High Pressure, Academy of Sciences, USSR). Pribery i Tekh. Ekspt. No. 1, 118-22(1960) Jan.-Feb. (In Russian)

A high-pressure compressor and methods for obtaining indication diagrams by means of various transducers are described. Descriptions are given of three types of transducers and their performance. An indicator diagram obtained by means of ion glow discharge is included. (tr-auth)

19075

PREPARATION OF URANIUM LAYERS BY EVAPORATION IN VACUUM. Yu. K. Gus'kov, A. V. Zvonarev, and V. P. Klychkova. Pribery i Tekh. Ekspt. No. 1, 143-4(1960) Jan.-Feb. (In Russian)

The design of a heater capable of operating for 50 hours and producing 30- to 40- μ layers of U_3O_8 after single evaporation is described. The heater can handle a load of 4 to 5 g of U_3O_8 , has an evaporation rate of ~ 10 g/hr, and produces U_3O_8 layers at 1 to 1.5 mg/min. Layers of U_3O_8 (50 to 80 μ) were prepared in an ordinary vacuum installation at vacuums of 10^{-4} to 10^{-5} mm mercury. (R.V.J.)

19076

WINDOW REINFORCEMENT FOR HIGH-PRESSURE AND LOW TEMPERATURES. S. A. Baldin and B. V. Gavrilovskii. Pribery i Tekh. Ekspt. No. 1, 144(1960) Jan.-Feb. (In Russian)

A gas container with a reinforced window to withstand high pressure (100 atm) at low temperature (-200°C) was developed. (R.V.J.)

19077

IMPROVEMENTS IN AND RELATING TO ELECTROMAGNETIC INTERACTION PUMPS OR DEVICES FOR USE IN METAL CASTING TECHNIQUES. (to La Soudure Electrique Autogene S. A. Procedes Arcos). British Patent 831,399. Mar. 30, 1960.

An electromagnetic interaction pump for controlling the rate of fall of molten metal is described. The pump is used for controlling the rate of flow of molten metals being cast in molds. (W.L.H.)

19078

IMPROVEMENTS RELATING TO VACUUM PUMPS. (to General Electric Co.). British Patent 831,697. Mar. 30, 1960.

The design of an ion vacuum pump which positively pumps the gas being treated is reported. The pump consists of an ion pumping chamber, means for producing ions from gas molecules, and means for directing these ions to a conductive or semi-conductive gas permeable membrane. (W.L.H.)

19079

AN IMPROVED REMOTE CONTROL MANIPULATOR. (to

United States Atomic Energy Commission). British Patent 834,663. May 11, 1960.

The design of a remote-control manipulator of the type in which motions of a master unit are reproduced by a slave unit is presented. This remote-control manipulator employs electrical connections between the master unit and the slave unit instead of mechanical connections. (W.L.H.)

19080

IMPROVEMENTS IN OR RELATING TO WINCHES FOR LIFTING RADIOACTIVE ARTICLES. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 836,228. June 1, 1960.

The design of a winch for lifting radioactive materials is described. The winch is shielded, and the drum of the winch is accessible for maintenance. (W.L.H.)

Heat Transfer and Fluid Flow

19081 JPL-TR-32-5

California Inst. of Tech., Pasadena. Jet Propulsion Lab. ELECTROGASDYNAMIC CHANNEL FLOW. Meredith C. Gourdine. Jan. 19, 1960. 21p. Contract NASw-6.

The mutual interaction between a one-dimensional steady flow of a positively charged gas and an applied electric field is investigated theoretically. It is shown that electrical energy can be converted into flow energy: when the percentage of ions is low, most of the electrical energy goes into thermal motion of the gas; when the percentage of ions is high, most of the electrical energy goes into directed motion. In the former case, for example, a subsonic flow ($M = 0.6$) or a supersonic flow ($M = 2.4$) can be driven sonic in a distance of 2 mm by the application of 80 Kv, if the percentage of ions is 2×10^{-6} . Methods of producing flows with an excess positive charge are discussed. (auth)

19082 LMSD-288139(Vol. I, Pt. 1)(Paper 1)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

THE EFFECT OF BODY FORCES ON MELTING ABLATION AT A STAGNATION POINT. D. M. Tellep. Paper 1 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 15p.

The effect of body forces on melting ablation in the stagnation region of a blunt body of revolution is considered. Solutions are obtained numerically after applying a similarity transform. It is found that body forces caused by vehicle deceleration lead to an increase in the interface temperature and a reduction in the melting rate. (auth)

19083 LMSD-288139(Vol. I, Pt. 1)(Paper 2)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

RADIANT-ENERGY TRANSFER IN GASEOUS FLOWS. D. M. Tellep and D. K. Edwards. Paper 2 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 42p.

The basic integral expressions for radiant energy transfer near a diffuse reflecting surface with uniform temperature are reviewed. The radiation diffusion approximation is also reviewed. Conservation of energy transferred by radiation, diffusion, conduction, and convection is formulated as an integro-partial differential equation for a gray chemically reacting gas in laminar

boundary-layer flow over a black wall. A similarity transform is introduced to reduce to flow equations a pair of simultaneous, ordinary integro-differential equations, and an iterative method of solution is indicated. It is also shown that when the radiation mean free path is small compared with the thermal boundary layer thickness, introduction of the Rosseland radiation diffusion approximation reduces the energy equation to the usual form, with an equivalent thermal conductivity depending partly on the optical properties of the fluid. (auth)

19084 LMSD-288139(Vol. I, Pt. 1)(Paper 3)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

A NUMERICAL METHOD OF SOLUTION FOR HEAT CONDUCTION IN COMPOSITE SLABS WITH A RECEDING SURFACE. J. J. Brogan. Paper 3 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 44p.

A numerical method of solution is presented for heat conduction in solids with a receding-surface boundary condition. Solutions are obtained by utilizing an explicit complete difference formulation of the heat-rate and energy-balance relations. Simplicity and versatility of the method permit inclusion of a variety of arbitrary initial and boundary conditions including heat conduction in composite slab systems. Accuracy of the method is shown by comparison of the present results with known numerical and analytical solutions. Sample numerical results are presented for an ablating hypervelocity vehicle, including the particular case where each material in a composite wall successively experiences the receding-surface boundary condition. (auth)

19085 LMSD-288139(Vol. I, Pt. 1)(Paper 4)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ON MASS TRANSFER AND SHOCK-GENERATED VORTICITY. H. Hoshizaki. Paper 4 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 41p.

The effects of shock-generated vorticity and mass transfer on stagnation-point heat-transfer rates are investigated. The complete incompressible Navier-Stokes equations are considered in the flow region between the bow shock and the surface of spheres and cylinders. Boundary conditions are applied immediately behind the shock and at the wall. The numerical solutions to the flow equations with air injection into the shock layer show that the interaction between the vorticity generated by the wall and by the curved shock reduces the effectiveness of mass-transfer cooling. The reduction in heat-transfer rates due to mass injection is substantially less than predicted by boundary-layer theory at Reynolds numbers below 10^5 for spheres and 10^4 for cylinders. The heat-transfer rates with mass injection were found to be 200 to 300% greater than corresponding boundary-layer values for the extreme cases investigated (strong shock, $Re \approx 10^3$, and large air injection rates). These heat-transfer rates are, however, less than the zero mass-injection values. It is also shown for a sphere and for $Pr = 1.0$, that the increase in heat transfer is primarily dependent on the inverse of the difference between the vorticity at the wall and the vorticity immediately behind the shock. An extension of the above analysis which is based on the independence principle shows that yawing the cylinder has a small effect on the increase in heat-transfer rates caused by vorticity interaction. (auth)

19086 LMSD-288139(Vol. I, Pt. 1)(Paper 5)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

THE EFFECT OF SHOCK-GENERATED VORTICITY, SURFACE SLIP, AND TEMPERATURE JUMP ON STAGNATION-POINT HEAT TRANSFER RATES. H. Hoshizaki. Paper 5 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 12p.

The combined effects of shock-generated vorticity, surface slip, and temperature jump on stagnation point heat rates are investigated. Numerical solutions to the incompressible Navier-Stokes equations were obtained in the shock layer in the vicinity of the stagnation point. The normal shock relations are used as the outer boundary conditions while the slip boundary conditions are used at the surface. The numerical solutions show that for an insulated body, surface slip and temperature jump reduce the heat rates by a substantial amount. (auth)

19087 LMSD-288139(Vol. I, Pt. 1)(Paper 6)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

HYPERSONIC FLOW AROUND BODIES OF REVOLUTION WHICH ARE GENERATED BY CONIC SECTIONS. M. Vinokur. Paper 6 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 28p.

The inviscid supersonic blunt-body problem is discussed. The flow around the family of bodies of revolution which are generated by conic sections is treated by neglecting variations in density. Two approximate analytic solutions are presented. In one, the shock wave is assumed to be locally confocal with the body. In the other, the shock curvature is assumed constant near the axis. Both solutions reduce to that of Lighthill in the case of the sphere. The results are compared with those of other theories, as well as with available experimental data. (auth)

19088 LMSD-288139(Vol. I, Pt. 1)(Paper 7)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

KINEMATIC FORMULATION OF ROTATIONAL GAS FLOW. M. Vinokur. Paper 7 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 23p.

It is shown that for the steady isoeenergetic rotational flow of an ideal gas both the specific enthalpy and the speed of sound can be expressed as functions of the velocity. As a result, it is possible to formulate the equations of motion so that the velocity is the only dependent variable. For a gas whose enthalpy and sound speed are functionally related, the results are a generalization of those for a perfect gas. If the enthalpy and sound speed are independent variables, the new formulation leads to a single vector equation whose solution completely determines the flow. (auth)

19089 LMSD-288139(Vol. I, Pt. 1)(Paper 8)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

HYPERSONIC FLOW AROUND BLUNT BODIES OF REVOLUTION WHOSE SHOCK WAVES ARE GENERATED BY CONIC SECTIONS. M. Vinokur and R. W. Sanders. Paper 8 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 28p.

The inviscid hypersonic blunt body problem is considered. The procedure given by Lighthill for the special case of a spherical shock wave is extended to the family

of conic shock shapes. Two approximations are required that limit the solution to the axis of symmetry. After the solution is obtained, certain flow parameters are calculated and (for three particular shock shapes) are compared with results from the numerical methods of Van Dyke and Mangler. (auth)

19090 LMSD-288139(Vol. I, Pt. 1)(Paper 9)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

INVISCID HYPERSOUND FLOW AROUND SPHERES WITH MASS INJECTION. M. Vinokur and R. W. Sanders. Paper 9 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 18p.

Lighthill's constant-density solution for the inviscid hypersonic flow around spheres is extended to include mass injection from the body. It is shown that the shock-layer thickness, injection-layer thickness, and surface-pressure distribution depend only on the injection momentum, for fixed free-stream conditions. The dependence is shown graphically for the case when the injection layer is irrotational. (auth)

19091 LMSD-288139(Vol. I, Pt. 1)(Paper 10)

Lockheed Aircraft Corp. Missiles and Space Div.,
Sunnyvale, Calif.

THIRD-ORDER CYLINDRICAL BLAST-WAVE THEORY AND ITS ANALOGY TO THE FLOW ABOUT HEMISPHERE-CYLINDER CONFIGURATIONS IN HIGH-SPEED FLIGHT. R. J. Swigart. Paper 10 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 46p.

The inviscid flow field behind a cylindrical blast wave and its analogy with the flow between the shock and body of a blunt-nosed slender body in steady flight at zero angle of attack are considered. Blast-wave theory as developed by Taylor for spherical waves and Lin for cylindrical waves is applicable when the shock wave is strong. The development of Sakurai for planar, cylindrical, and spherical waves is applicable at all shock strengths. However, to the second order, the accuracy of Sakurai's solution decreases with decreasing blast-wave Mach numbers. To improve the accuracy of cylindrical theory at lower Mach numbers, Sakurai's work is extended to include third-order terms. Third-order shock-wave shapes about hemisphere-cylinder configurations at $M_\infty = 3.24$ and 7.7 are compared with second-order solutions and experimental data by applying the above analogy. Third-order surface pressure distributions on a hemisphere cylinder are compared with the second-order solution and experimental data at $M_\infty = 7.7$ and with the second-order solution and a characteristic solution at $M_\infty = 17.98$. Third-order theory improves agreement of predicted pressure-distribution curve slopes with those determined experimentally or by theoretical numerical methods. Third-order theory is, however, somewhat less satisfactory than second-order theory for predicting shock-wave shapes. (auth)

19092 LMSD-288139(Vol. I, Pt. 2)(Paper 2)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

A NOTE REGARDING STAGNATION-POINT RADIATION HEAT TRANSFER. R. W. Rutowski. Paper 2 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 11p.

It is concluded that stagnation point heat-transfer rates in a partially ionized gas can be satisfactorily represented by the sum of predicted radiation and convection heat-transfer rates. (W.D.M.)

19093 LMSD-288139(Vol. I, Pt. 2) (Paper 3)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

FORMATION OF NITRIC OXIDE BEHIND STRONG SHOCK WAVES IN AIR. J. J. Allport. Paper 3 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 25p.

Infrared emission studies were made of the formation of nitric oxide in shocked air. The formation of NO was observed by monitoring the radiation from the fundamental band at 1875.9 cm^{-1} , as a function of time after passage of the shock wave. Experiments were carried out using a 3-in. shock tube at Mach 8 to 14, and with initial pressures of 10 and 5 mm Hg of dry, argon-free air. The experiments corroborate recent theoretical investigations which predict that the transient NO concentration exceeds its equilibrium value. Following passage of a shock at Mach 8, the nitric oxide concentration grows slowly for $200\text{ }\mu\text{sec}$, and no overshoot in concentration was observed. But after passage of shocks at Mach 11 and 14, there were overshoots of 11 and 100%, respectively, of the equilibrium concentration. Measurements of the absolute intensity of the radiation at 1875.9 cm^{-1} from the nitric oxide formed at equilibrium in shocked air were 15% higher than the prediction of Breene. (auth)

19094 LMSD-288139(Vol. I, Pt. 2) (Paper 4)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STEADY TWO-DIMENSIONAL FLOW WITH A TRANSVERSE MAGNETIC FIELD. M. Mitchner. Paper 4 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 22p.

Equations are developed for the steady, two-dimensional, isentropic, and irrotational flow of a perfect electrically conducting fluid in a transverse magnetic field. For very strong magnetic fields the magnetohydrodynamic equations are identical to the corresponding hydrodynamic equations specialized to a gas with a ratio of specific heats equal to two and with the sound velocity replaced by the total disturbance velocity. The effect of the magnetic field on the Bernoulli equation is examined, and the characteristic curves in the hodograph plane calculated for the case of supersonic flow. It is shown that a magnetic field causes a more rapid expansion for flow around a convex curved wall, and causes the shock produced in flow around a concave curved wall to move upstream. For comparable Mach numbers these effects are relatively small, even for very strong fields. (auth)

19095 LMSD-288139(Vol. I, Pt. 2)(Paper 6)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

SOME REFLECTED SHOCK PARAMETERS IN N_2 AND O_2 . M. Scheibe. Paper 6 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 19p.

Reflected shock parameters were calculated for several initial conditions in N_2 and O_2 using an IBM 704 code developed at Los Alamos Scientific Laboratory. The species included were N_2 , N , N_2^+ , O_2 , O , O_2^+ , O^+ , N^+ , O_2^- , O^- , O_3 , and e. (auth)

19096 LMSD-288139(Vol. I, Pt. 2)(Paper 7)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STAGNATION-POINT HEAT TRANSFER MEASUREMENTS IN HYPERSONIC, LOW-DENSITY FLOW. S. E. Neice,

R. W. Rutowski, and K. K. Chan. Paper 7 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 22p.

An experimental investigation of the heat-transfer rates at the stagnation point of a hemisphere cylinder in a hypersonic, low-density stream is described. The experiments were undertaken to assess prior theoretical predictions that such heat-transfer rates would be greater than those predicted by the more customary boundary-layer theories. Experiments were conducted in a shock-tunnel adaptation of a combustion-driven shock tube at free-stream Reynolds numbers, based on the one-inch nose radius, from 170 to 2700 and a Mach number of about 6. The test results appear to be in agreement with the theoretical predictions. (auth)

19097 NAA-SR-3775

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMAL PERFORMANCE OF THE SRE MAIN INTERMEDIATE HEAT EXCHANGER. K. W. Foster. June 15, 1960. 66p. Contract AT-11-1-GEN-8. OTS.

The sodium-to-sodium main intermediate heat exchanger in the Sodium Reactor Experiment was investigated from the aspect of steady state and transient thermal performance. The experimental steady state log-mean temperature difference at design conditions was found to be 42% above the calculated value. The theoretical shellside Nusselt number used in the design heat transfer rating was 209% above the experimental value. Lower than expected performance on the shellside was attributed to: greater than 20 but less than 60% of the shellside fluid bypassing the tube bundle between the outer tubes and the shell wall and baffle design which did not promote the high mass velocities anticipated on the shellside of the unit. Theoretical calculations backed up by experimental data reveal that, after a scram, large temperature differences exist in the shell and tubes, and in some cases reverse flow occurs in the lower tubes. Methods for preventing reverse flow in heat exchangers are discussed. (auth)

19098 NAA-SR-Memo-3528

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EXPERIMENTAL EVALUATION OF CONCENTRIC CYLINDER, SPIRAL-FLOW HEAT EXCHANGER. J. S. McDonald. Mar. 9, 1959. 31p. OTS.

The design, fabrication, and experimental evaluation of a 100 kw model of a concentric cylinder, spiral-flow heat exchanger are discussed. Heat transfer and thermal stress resistance of the unit were investigated in a figure-eight Na system. Expressions for the Nusselt numbers for Na flowing in rectangular passages were derived for effective heat flow through two opposite walls and effective heat flow through only one wall. (C.J.G.)

19099 OOR-407.51

Maryland. Univ., College Park.

FUNDAMENTAL RESEARCH IN APPLIED MATHEMATICS. FURTHER RESULTS ON THE FLOW OF A CONDUCTING FLUID PAST A MAGNETIZED SPHERE. Interim Technical Report No. 42. G. S. S. Ludford. Nov. 1959. 10p. DA Project No. 5B99-01-004. Contract DA-36-034-ORD-1486. (AD-230148).

The steady flow of an incompressible, inviscid, conducting fluid past a magnetized sphere was investigated. The results showed that the singularity in the vorticity can only be absent when the undisturbed magnetic field vanished at the front stagnation point. Explicit formulas for the drag

were derived in terms of coefficients defining the distribution; the drag was the same for image distributions with respect to the $\theta = \pi/2$. The drag due to an off-center dipole was computed and found to be larger than for a centered dipole of the same moment. (C.J.G.)

19100 OOR-1534-2

Johns Hopkins Univ., Baltimore.

TRANSIENT GAS FLOW IN POROUS MEDIA—THE PRESSURE DECAY PROCESS. Final Technical Report. Eric Weger and David B. Greenberg. May 1960. 71p. DA Project No. 5B99-01-004. Contracts DA-36-034-ORD-2353 and DA-36-034-509-ORD-3RD.

An experimental method was developed for initiating, following, and recording rapid transient fluctuations in fluid pressure in a porous medium. The porous materials were composed of sintered metallic powders (tin-coated spherical copper particles and nickel spheres) covering a range of particle sizes. It was determined that solutions obtained by using the equation of motion, including a term for inertial flow, are valid for the description of pressure decay in consolidated porous media with high initial pressures. General correlations for this process, based on experimental and computed results, were obtained. (C.J.G.)

19101 RM-2244(RAND)

RAND Corp., Santa Monica, Calif.

HEAT TRANSFER IN A DISSOCIATING GAS. Phyllis Greifinger. Aug. 28, 1958. 46p. (AD-230074).

The effects of finite reaction kinetics on heat transfer were evaluated for a chemically reacting gas ($X_2 \rightleftharpoons 2X$) confined between two stationary infinite parallel plates maintained at different temperatures. Surface reaction rates at the hot plate were assumed to be such as to keep the concentrations at their equilibrium values at the hot wall, but a variety of reaction rates on the surface of the cold wall was considered. Solutions were found for the limiting cases of infinite and zero homogeneous reaction rates. Approximate solutions for arbitrary reaction rates were found such that the equilibrium degree of dissociation had intermediate values in the region between the plates and very small values at the cold wall. The results for the concentration and temperature profiles and the heat transfer as a function of the reaction rate parameters are shown graphically for oxygen in the dissociation region. (M.C.G.)

19102 SSC-107

Battelle Memorial Inst., Columbus, Ohio.

EVALUATION OF WELD-JOINT FLAWS AS INITIATING POINTS OF BRITTLE FRACTURE. Final Report. R. P. Sopher, A. L. Lowe, Jr., and P. J. Rieppel. Aug. 29, 1958. 55p. Project No. SR-131. Contract NObs-61748. (PB-161323). OTS.

A study was made of the conditions needed for initiation of a brittle fracture from flaws 4 in. or less in length. Experiments performed demonstrated that residual and reaction stresses (local stresses) join with applied stresses to make up the total stress that is involved in the initiation of many brittle fractures. If local stresses are high in the vicinity of a flaw, then the applied stress may be low when brittle fracture initiates from that flaw provided that the steel is at or near the nil ductility temperature (NDT). Stress conditions that are expected to exist in ship structures were incorporated in the test specimen. Various techniques were employed to determine the magnitude of the stresses in the area of the flaw front. Some brittle fractures were initiated from flaws 4 in. or less in length at an applied stress of less than 6000 psi. Thus the results provided some insight concerning the state of stress that probably existed in structures that failed in service at low

applied stress. Service failures and the results obtained on this project show that flaws (especially cracks) of almost any size are potential initiation points of brittle fracture. On the other hand, these results showed that a total stress of yield-point value or higher, in conjunction with some stress-raising condition, is necessary to initiate brittle fracture under service conditions from flaws of various sizes and types (such as a crack or lack of fusion in a weld joint). It takes a combination of conditions to initiate a brittle fracture. (auth)

19103 SUDAER-90

Stanford Univ., Calif.

HEAT CONDUCTION AND THERMAL STRESSES IN A SOLID HAVING UNEQUAL SPECIFIC HEATS. E. W. Parkes. Feb. 1960. 24p. Contract AF49(638)-223. (AFOSR-TN-60-320).

It is usual in thermoelastic analyses to separate the heat conduction and stressing problems. This division can only be justified if the specific heat at zero stress for the material is closely equal to that at zero strain. For some materials at present under consideration for missile construction, the ratio of specific heats may depart from unity by 25%. The transient temperature distribution and thermal stresses in a solid subjected to one-dimensional heat flow and various kinds of stress-inducing restraints are investigated, when the specific heats are unequal. Allowance is made for the stress terms in the heat conduction equation (which are ignored when the analysis is divided) and for the variation of specific heat with temperature. It is concluded that the errors introduced by the conventional approach, although not entirely negligible, are not such as to justify the labor involved in the more correct analysis. (auth)

19104 WAPD-BT-18(p.85-90)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

NON-STEADY FLUID DRAG. J. A. Keane. p.85-90 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

The effect of fluid on the dynamic response of bodies to external excitations is of interest to the designers of pressurized water reactors for marine applications. The results are given of an experiment performed to obtain an analytical model for describing fluid drag forces in oscillatory motion. It was found that the resistive force between the fluid and the body vibrating in the fluid appeared to be proportional to the square of the relative velocity between the fluid and the body in the limited range tested. (auth)

19105 WAPD-BT-18(p.91-7)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

STEADY-STATE TWO-DIMENSIONAL FLOW OF WATER WITH BOILING IN NON-UNIFORMLY HEATED RECTANGULAR DUCTS. R. I. Miller. p.91-7 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

MITE-02, an IBM-704 FORTRAN code, calculates the two-dimensional steady-state flow distribution within a vertical rectangular channel. The two-dimensional transfer of mass, momentum, and energy are described throughout the subcooled, nucleate boiling, and bulk boiling regions of the coolant. The model was experimentally verified and is intended for use as a design tool. (auth)

19106

STEADY AND TRANSIENT FREE CONVECTION OF AN ELECTRICALLY CONDUCTING FLUID FROM A VERTICAL PLATE IN THE PRESENCE OF A MAGNETIC FIELD. A. S. Gupta (Indian Inst. of Tech., Kharagpur). Appl. Sci. Research 9A, 319-33(1960). (In English)

An analysis is made for the laminar free convection and

heat transfer of a viscous electrically conducting fluid from a hot vertical plate when the induced field is negligible compared to the imposed magnetic field. It is found that similar solutions for velocity and temperature exist when the imposed magnetic field (acting perpendicular to the plate) varies inversely as the fourth root of the distance from the lowest end of the plate. Explicit expressions for velocity, temperature, boundary layer thickness and Nusselt number are obtained and the effect of a magnetic field on them is studied. It is found that the effect of the magnetic field is to decrease the rate of heat transfer from the wall. In the second part, the method of characteristics is employed to obtain solutions of the time-dependent hydromagnetic free convection equations (hyperbolic) of momentum and energy put into integral form. The results yield the time required for the steady flow to be established, and the effect of the magnetic field on this time is studied. (auth)

19107

ON A NON-LINEAR PROBLEM POSED BY THE TEMPERATURE DETERMINATION IN AN ELECTRICALLY HEATED PLATE. Robert Gerber (Centre d'Études Nucléaires, Grenoble, France). *Compt. rend.* **247**, 708-10 (1958) Aug. 25. (In French)

A flat plate, electrically heated, with one face thermally insulated and the other face isothermal is considered. It is shown that a two-dimensional perturbation of the insulated face has no influence on the temperature of this face. (auth)

19108

THE FLOW OF A CONDUCTING LIQUID CROSSING A DIAPHRAGM IN THE PRESENCE OF A MAGNETIC FIELD. Étienne Crausse and Yves Poirier (Faculté des Sciences, Algiers). *Compt. rend.* **250**, 3573-5 (1960) May 30. (In French)

The expression of the charge loss created by the diaphragm appears in the form of a binomial having one term proportional to the velocity and dependent on the magnetic induction and a second term proportional to the square of the velocity and independent of the induction. (tr-auth)

19109

DEVELOPMENT TESTING OF LIQUID METAL AND MOLTEN SALT HEAT EXCHANGERS. R. E. MacPherson, J. C. Amos, and H. W. Savage (Oak Ridge National Lab., Tenn.). *Nuclear Sci. and Eng.* **8**, 14-20 (1960) July.

In order to investigate the design and fabrication problems inherent in compact, high-performance heat exchangers for aircraft nuclear propulsion applications, extensive development testing was done on bifluid (molten salt-NaK) heat exchangers and on liquid metal (NaK-air) radiators. These test units were prototypes of the heat transfer equipment which was to be used in the Aircraft Reactor Test (ART) at ORNL. Five bifluid test loops and one liquid metal test loop were used for performance and endurance testing of these components at simulated reactor operating conditions. The molten salt used was a ternary mixture of composition NaF 50 mole %, ZrF₄ 46 mole %, UF₄ 4 mole %. The NaK used was 56 wt % Na and 44 wt % K. A total of 47,000 hr of operation at 1200 to 1700°F was accumulated on 18 heat exchangers and 20 radiators. The program demonstrated that the compact heat exchanger geometries tested possessed the performance capabilities and mechanical integrity to meet ART design requirements. (auth)

19110

DESIGN PRECEPTS FOR HIGH-TEMPERATURE HEAT EXCHANGERS. A. P. Fraas (Oak Ridge National Lab., Tenn.). *Nuclear Sci. and Eng.* **8**, 21-31 (1960) July.

While it is evident that weight and volume are vitally

important in aircraft power plants, there is also a strong incentive in stationary and marine power plants to reduce both weight and volume because of such considerations as shielding, remote handling, liquid inventory, reactor hazards, control response rates, costs, etc. Analysis disclosed that the tube diameter should be as small as possible consistent with limitations imposed by deposits on the tube walls. Test experience demonstrated the practicality of tube diameters from $\frac{1}{4}$ to $\frac{1}{8}$ in. OD. It was found that thermal stresses imposed the most important single set of fundamental limitations on the heat exchanger design, and that thermal strain cycling associated with changes from low to high power was the most important failure mechanism. This, coupled with leak tightness requirements, made it essential that a ductile material be employed. The metal also had to be well suited to both welding and brazing because the only thoroughly satisfactory tube-to-header joints tested were first welded and then back-brazed. A series of heat exchangers designed according to these precepts was built and endurance tested at power densities as high as 10 Mw/ft³ (350 kw/liter). Many of the units were endurance tested for over 1000 hr at temperatures up to 1500°F. (auth)

19111

EVALUATION OF THE PERFORMANCE OF LIQUID METAL AND MOLTEN SALT HEAT EXCHANGERS. M. M. Yarosh (Oak Ridge National Lab., Tenn.). *Nuclear Sci. and Eng.* **8**, 32-43 (1960) July.

Heat transfer and pressure drop test data were obtained on liquid metal-to-molten salt heat exchangers and on liquid metal-to-air radiators. The data were correlated to permit predictions of the heat transfer and pressure drop performance of heat exchange equipment to be used on the Aircraft Reactor Test. The test results agreed well with analytical predictions using the Dittus-Boelter and Kaufman-Lubarsky equations except that in the transition region from laminar to turbulent flow marked differences were found in the heat transfer coefficients for flow through round tubes and axial flow between tubes. These differences appeared to stem in part from the irregular geometry of the flow passage between tubes and from the tube spacers employed. (auth)

19112

PRECISE TRACER MEASUREMENTS OF LIQUID AND GAS FLOWS. Colin G. Clayton (Atomic Energy Research Establishment, Wantage, Berks, Eng.). *Nucleonics* **18**, No. 7, 96-100 (1960) July.

A series of tests was made on radioactive tracer methods for liquid (Na²⁴) and gas (Kr⁸⁵) flow. (1) Liquid Flow. Both isotope dilution and velocity methods were used, and special pumps were constructed for each. It is concluded that the velocity method is the better because it is easier to get a short, sharp injection than a smooth, continuous one, and the centroid of the peak is used as a timing reference. (2) Gas Flow. The differences between gas and liquid flow with respect to tracers are outlined. It was found that the isotope dilution method is too difficult. A special pump was devised for injecting a sample at pipe pressure without precompression. The results show that Sjenitzer's calculations for liquid flow apply also for gases. (D.L.C.)

19113

ABOUT LAMINAR BOUNDARY LAYER ON A PLATE IN NON-HOMOGENEOUS FLOW. O. N. Ovchinnikov (Kalinin Leningrad Polytechnical Inst.). *Zhur. Tekh. Fiz.* **30**, 627-38 (1960) June. (In Russian)

Dynamic and thermal interface layers at a plane in viscous incompressible fluid flow with cross gradient veloci-

ties and temperatures are analyzed. The problem is resolved by the method of asymptotic layers, and the solution is presented as a series of Reynolds' numbers. It is shown that even a small heterogeneity of the incoming flux influences the dynamic and thermal parameters of the interface layer. (R.V.J.)

19114

RAREFIED GAS DYNAMICS. Proceedings of the First International Symposium held at Nice. F. M. Devienne, ed. International Series on Aeronautical Sciences and Space Flight. Division IX. Symposia. Volume 3. New York, Pergamon Press, 1960. 449p. \$17.50.

The proceedings of the First International Symposium on Rarefied Gas Dynamics are presented. Authoritative papers read and the resulting discussions on design and theory are included as well as the experimental aspects of rarefied gas dynamics and aerothermodynamics. It is felt that this collection of papers will be of great interest to workers in the fields of aerodynamics, aeronautics, and allied subjects. (B.O.G.)

19115

PROCEEDINGS OF THE 1960 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE, STANFORD UNIVERSITY, CALIFORNIA, JUNE 15, 16, 17, 1960. David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960. 266p.

Eighteen papers are included. Separate abstracts have been prepared for the six papers most applicable to nuclear science. (D.E.B.)

19116

AN EXPERIMENTAL STUDY OF GAS DYNAMICS IN HIGH VELOCITY VORTEX FLOW. J. J. Keyes, Jr. (Oak Ridge National Lab., Tenn.). p.31-46 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

For effective application of high velocity vortex flow to heat transfer and gas separation, a knowledge of the interrelationship of the vortex strength and the turbulent energy dissipation is needed. An experiment was designed to study the nature of the flow in a simple, jet-driven vortex tube under closely controlled conditions approximating two dimensionality of the flow field. The vortex was generated either by nozzles spaced uniformly along the length of the tube or by a continuous slit; gas was removed through an orifice at the center of one end of the tube. The radial static pressure distribution, measured at the closed end of the tube, was graphically differentiated to determine the tangential velocity profile. Tangential velocities were measured in tubes of $\frac{5}{8}$ -, 1-, and 2-in. ID, using nitrogen and helium gas, at tube wall pressures of 2.5 to 135 psia. It was found that the tangential peripheral velocity data correlate reasonably well in terms of the inlet jet kinetic energy and the tangential peripheral Reynolds number based on the tube diameter. Supersonic tangential velocities were achieved at small radii in some runs. To establish the degree of turbulence in vortex flow, estimates of the virtual (total) viscosity were made from the experimentally measured variation in tangential velocity with radius. It was found that the virtual viscosity near the tube periphery was 30 to 700 times the molecular viscosity for tangential peripheral Reynolds numbers of 4×10^4 to 1.6×10^6 . It is estimated that flow in a near-sonic-jet-driven vortex tube will in all probability be turbulent at wall pressures in excess of a few tenths psia. (auth)

19117

EXPLOSIVE DECOMPRESSION OF WATER. E. A. Brown, Jr. (Armour Research Foundation, Chicago). p.135-49 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

Explosive decompression of water was considered theoretically in the simplified one-dimensional form, and the results were compared with preliminary shock tube measurements. A thermodynamic equilibrium type expansion was considered, which led to the usual centered rarefaction wave with an isentropic change of state. An order of magnitude argument was used to show why such a process was unlikely to occur. A two step expansion process was analyzed wherein the liquid expands into a metastable state then relaxes into an equilibrium two phase mixture. The limiting case of zero entropy change was considered. This resulted in a maximum value for the metastable liquid pressure and a description of the pressure-time history in the shock tube. The experimental measurements indicated that the thermal equilibrium type expansion was not prevalent. The metastable pressure for the one set of initial liquid conditions tested was nearly constant. The shock tube experiments for which the metastable pressure was less than the calculated maximum value showed that the measured pressure-time records were in agreement with the analysis. In the tests for which the measured metastable pressure was greater than the calculated maximum, the shock tube pressure-time records showed that the two-step expansion did not adequately explain the explosive decompression process. (auth)

19118

AN EXPERIMENTAL STUDY OF THE TRANSITION FROM NUCLEATE TO FILM BOILING UNDER ZERO-GRAVITY CONDITIONS. Hans F. Steinle (Convair, San Diego, Calif.). p.208-19 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

Drop tests of an electrically heated platinum wire horizontally submerged in a pool of Freon-114 were performed to study the transition from nucleate to film boiling under zero-gravity conditions at atmospheric pressure. The change of the wire temperature as a function of time was recorded by use of an oscillograph and an oscillograph-record camera. The drop distance was nine feet, giving an approximate zero-gravity condition for about 0.75 seconds. Data relating heat flux to temperature difference between heater and liquid were collected and plotted, and were compared with the one-g condition. With the heating rates used in this study, boiling under zero-g started sooner and at a lower heating rate than under one-g, with no or only a very small period of natural convection. Nucleate boiling appeared to be time dependent and was present only for a few milliseconds. Film boiling occurred with repeatability in zero-g, at heat fluxes which would permit only nucleate boiling under one-g. It follows that the transition from nucleate to film boiling is clearly sensitive to the gravitational acceleration. Due to the time dependence of the nucleate period, no clear boiling transition point from nucleate to film boiling was found under zero-g. (auth)

19119

MINIMUM MASS THIN FINS FOR SPACE RADIATORS. J. Ernest Wilkins, Jr. (Nuclear Development Corp. of

America, White Plains, N. Y.). p.229-43 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

An analysis is presented of the reduction in mass of two-dimensional thin fins which can be achieved by properly shaping the fin profile. The principal discussion is devoted to fins which transfer heat only by radiation to surroundings at 0°R (the principal case). The methods employed will handle any temperature dependent heat dissipation mechanism (e.g., combined convection and radiation with temperature dependent emissivity, thermal conductivity, and heat transfer coefficient). For the principal case the optimum fin has 61.2% of the mass of the lightest rectangular fin with an insulated tip and 90.6% of the mass of the lightest triangular fin. Curves are presented showing the effect of a constant nonzero temperature of the surroundings. The optimum fin profiles have a sharp tip and are unacceptable whenever fins must be joined for structural or other reasons. If a minimum thickness is specified the optimum fin may be built up by replacing its tip with a rectangular portion of the desired thickness. For the principal case the effect of this process on the fin mass is determined. A trapezoidal fin with the given minimum thickness is only slightly (<10%) more massive than the built up fin. The developed methods can be used in a number of related minimum problems. Some results on spines of minimum mass and on fins whose height is restricted to be smaller than that of the ideal optimum fin are presented. (auth)

19120

WEIGHT OPTIMIZATION OF HEAT REJECTION SYSTEMS FOR SPACE APPLICATIONS. C. L. Walker, C. R. Smith, and D. G. Gritton (General Motors Corp., Indianapolis). p.244-59 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

Weight optimization is reported for fin-and-tube type thermal radiators designed for space satellite applications. Weight of each component of the radiator is minimized using the following parameters: weight per linear foot of tubing and heat dissipation rate per linear foot of tubing. A numerical method for radiator fin design is described. Meteorite puncture probability considerations are included which dictate the tube and header design. Correlations for various parameters are presented based on calculations for heat loads of 10^4 to 10^6 Btu/hr and average coolant temperature of 500 to 1000°R. An exponential expression for the total weight in terms of heat load and coolant temperature is suggested. (auth)

Instrumentation

19121 60-GC-71

General Electric Co. Research Lab., Schenectady, N. Y. HIGH-ENERGY NUCLEAR PHYSICS RESEARCH PROGRAM. Final Report [for] December 1, 1946 to December 1, 1959. W. B. Jones, Dec. 15, 1959. 10p. Contract N7onr-332(01). (AD-230162). OTS.

A final summary was made of the technical activities in connection with the program of high-energy accelerator development and research in high-energy nuclear physics. A 300-Mev nonferromagnetic electron synchrotron was developed and operated 4800 hours in connection with the

high-energy experimental physics program. A liquid hydrogen bubble chamber, a 250-Mev total absorption Cherenkov counter, and a 300-Mev magnetic pair spectrometer were constructed. In the experimental program, three types of interactions were investigated: large-angle elastic scattering of photons by protons, inelastic interactions between photons and protons giving rise to the production of neutral and positive pions, and total absorption of photons in hydrogen to study electromagnetic interactions. A list of the publications and reports that resulted from this work was also included. (M.C.G.)

19122 AD-228397

Battelle Memorial Inst., Columbus, Ohio.

FIRST QUARTERLY PROGRESS REPORT ON EXPERIMENTAL AND RESEARCH WORK IN NEUTRON DOSIMETRY. Period covered: May 15 to August 15, 1959. J. E. Drennan and C. S. Peet. Aug. 15, 1959. 10p. Contract DA-36-039 SC-78924.

The need for a tactical neutron dosimeter which is sensitive in the same range as human tissue is discussed. Such a dosimeter should be small, lightweight, and provide a continuously observable indication of total dose. Several mechanisms which might be used in such a dosimeter were evaluated. As a result of this research, it appeared that silicon-diffused rectifiers would satisfy the need. This dosimeter works on the principal that the charge-carrier lifetime in semiconductors is an extremely sensitive indicator of damage resulting from neutron irradiation. Previously developed processing techniques for the preparation of wide-base, conductivity-modulated, silicon-diffused rectifiers are being employed for the preparation of a set of experimental units. These processing techniques will provide a base from which any modifications found necessary can be made. A statistically designed experiment was planned which will use the experimental units and which should not only be useful for the determination of the optimum geometry and forward voltage for the conductivity-modulated silicon diode for use in neutron dosimetry, but also provide necessary information for the design of associated measurement circuitry. The development of measurement circuitry for use in the experimental program was initiated, and experience gained in this work should prove useful in the design of circuitry for the prototype neutron dosimeter. Theoretical and experimental investigations pertaining to the physical phenomena involved in the rectifier were initiated. Measurements of various parameters of experimental rectifiers constructed in the previous project were made. (auth)

19123 AD-233583

Emory Univ., Ga.

TRIPLE COINCIDENCE POSITRON SPECTROMETRY (thesis). John Michael Palms. 1959. 60p.

The detection of low-level positron emission by a triple-coincidence scintillation spectrometer was investigated. Measurements on the positron spectrum of Zn^{65} showed a reasonable agreement with those of previous workers. An extensive analysis of the spectrometer for measuring positron spectra was made relative to stability, resolution, and dependability. (C.J.G.)

19124 AE-33

Aktiebolaget Atomenergi, Stockholm.

AN EMERGENCY DOSIMETER FOR NEUTRONS. J. Braun and R. Nilsson. May 1960. 33p.

A neutron dosimeter, suitable for single emergency exposures, is described. The dosimeter contains films of Al, Au, and Cd which can detect thermal, epi-thermal, and fast neutrons. Three of the constants by which the spec-

trum of the incident neutron flux is approximated, can therefore be determined. The dose calculated from these approximated spectra is compared to the dose from spectra obtained in different standard spectra of types which may be expected in a radiation accident. (auth)

19125 AERE-M-660

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN EXPERIMENTAL RADON-IN-AIR MONITOR. W. G. Sparke and J. A. B. Gibson. Apr. 1960. 17p.

An instrument was designed to detect radon in air at or about a level of 10^{-13} curies of radon per cm^3 of air. The 5.5 Mev α particle emitted in the decay of radon (^{222}Rn) to radium A (^{218}Po) is detected by a large screen scintillation counter. The instrument measures the pulse rate, due to these α particles, from the scintillation counter and hence the radon-in-air concentration. The measured sensitivity for 10^{-13} curies of radon per cm^3 of air is 5 counts per second; the background level is less than 0.4 counts per second. The activity level is displayed on a meter in terms of counts per second on successive ranges from 1 to 10^5 counts per second full scale and facilities are available for operation of a chart recorder. An audible warning circuit is incorporated and this may be set to operate at any convenient level. (auth)

19126 AERE-M-677

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE INDUCED CHARGE METHOD OF READING CONDENSER DOSIMETERS. E. H. Cooke-Yarborough. Apr. 1960. 11p. BIS.

Certain improvements were made in the pocket condenser-chamber dosimeter with the object of increasing its reliability and accuracy, and of allowing the dose received to be read as often as required without affecting the charge on the chamber. It is proposed that the improved dosimeter might be cheaper and more sensitive than a quartz fiber dosimeter and might be widely used as a supplement to film badges, allowing the latter to be developed less frequently than at present. (auth)

19127 AERE-R-3115

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A SENSITIVE DIRECT-READING POCKET-SIZE GAMMA DOSIMETER. J. H. Howes. May 1960. 13p. BIS.

A direct-reading gamma dosimeter with a sensitivity of approximately 20 mr, suitable for carrying in a laboratory coat pocket, was designed. The instrument measured gamma radiation dose by using a simple ionization chamber. Three models of this instrument were made, and over a period of several months use they proved reliable. (M.C.G.)

19128 AERE-R-3272

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN APPARATUS FOR SAMPLING THE STRATOSPHERE. P. Goldsmith and A. G. Parham. Apr. 1960. 13p. BIS.

A balloon-borne apparatus for sampling air at heights of about 100,000 feet is described. The apparatus was designed to collect samples of water vapor and carbon dioxide by means of a vapor trap cooled in liquid nitrogen. It was carried to altitudes of 80,000 to 100,000 feet by balloon. The total weight of the apparatus is 95 lbs, which

includes 6 lbs of coolant. In the period April to June 1959 four samples were obtained at mean heights of 92,500, 91,300, 90,000, and 80,000 feet. (auth)

19129 AFOSR-TN-60-375

Brown Univ., Providence.

DESIGN AND OPERATION OF AN OSCILLATING-BODY VISCOMETER FOR GASES AT HIGH PRESSURES. Technical Report No. 12. J. Kestin and W. Leidenfrost. Mar. 1960. 81p. Contract AF18(600)-891. OTS.

A description of the design and operating experience obtained with various types of oscillating-body high-precision viscometers is presented. An oscillating system consisting of a flat, circular disk oscillating between two close-together flat plates produced satisfactory results. Other oscillating systems which were found to be unsatisfactory are also discussed. (J.R.D.)

19130 AFOSR-TN-60-533

Stanford Univ., Calif.

ANALYSIS OF A MAGNETIC RESONANCE SPECTROMETER. Technical Note No. 131-5. J. P. Goldsborough and M. Mandel. June 1960. 14p. Project No. 37506(9751). Contract AF18(603)-131.

An electron paramagnetic resonance microwave bridge spectrometer is analyzed for the case of a reflection cavity and magic tee bridge. Expressions for the relation between the signal and the imaginary part of the magnetic susceptibility are derived. From this relation conditions for maximum signal are obtained. (C.J.G.)

19131 AFOSR-TN-60-661

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

DRIFT TUBE-MASS SPECTROMETER FOR STUDIES OF THERMAL-ENERGY ION-MOLECULE REACTIONS. Technical Report No. 3. E. W. McDaniel and D. W. Martin. June 20, 1960. 38p. Project No. A-251. Contract AF18(600)-1524.

Apparatus was developed for the mass spectrographic study of ion-molecule reactions occurring under gas-kinetic conditions at thermal energies. Ions are produced inside a two-foot-long drift space containing gas at a pressure of 0.7 mm Hg. A thermionic source utilizing a thoriated iridium filament is used for this purpose. The ions diffuse down the drift tube under the action of a weak electric field and pass through a small aperture at the end into a field-free, two-stage differential pumping chamber. From the second stage of this chamber the ions enter a 60° magnetic deflection mass spectrometer. The number of ion-molecule collisions in the drift tube may be varied over a wide range by changing the source position and the gas pressure. Information concerning the nature and probability of various reactions is revealed by the resulting changes in mass spectra. The apparatus may also be used for surface reaction studies, ionic mobility measurements, and for crude investigations of the lifetimes of unstable ions against spontaneous disintegration. (auth)

19132 AFSWP-1084

Defense Atomic Support Agency, Washington, D. C.

DATA REDUCTION PROCEDURES FOR NUCLEAR AIR BLAST INSTRUMENTATION. Jack R. Kelso, ed. Aug. 1959. 242p. (AD-231406).

An initial conference on Nuclear Air Blast Instrumentation was held at Albuquerque, New Mexico, on February 26 to 27, 1958. Formal and informal presentations were made which led to the development of a standardized nomenclature and detailed data reduction procedures. These presentations are reported verbatim, together with a résumé of blast dynamic pressure studies and proposals for future

work. The data reduction procedures for dynamic pressure were reviewed in conjunction with subsequent laboratory work at a second meeting in Albuquerque on August 12, 1958 and substantially verified. In addition, the progress made in implementing these procedures as well as the development of improved gages were discussed. The proceedings of this meeting appear in summarized form. (auth)

19133 AI-4248

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SUMMARY OF THERMOELECTRIC AND THERMIONIC CONVERSION TECHNOLOGY. N. S. Rasor. Mar. 1959. 33p.

The features of thermionic emission and thermoelectricity were studied and compared. An extensive derivation of the basic performance of the thermionic converter was made. Thermoelectric conversion was found to be less thermally efficient than thermionic conversion. A comparison of fraction Carnot efficiency, usable energy transport, extraneous energy transport, and figure of merit was made for thermoelectric and thermionic converters. The best demonstrated performances for converters are summarized along with their apparent status. (M.C.G.)

19134 CREL-928

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

A STABLE AMPLITUDE PULSE GENERATOR FOR TESTING NUCLEONIC INSTRUMENTS. V. H. Allen. Apr. 1960. 17p. (AECL-1009).

A generator which produces pulses of stable amplitude and pre-set shape was designed for testing pulse amplitude analyzers and associated pulse amplifiers. The pulse is generated by means of a mechanical mercury-wetted contact relay which derives its voltage from a source closely regulated by a gas reference tube. Pulse repetition rate can be changed, rise and fall times selected from five pre-set values, and the pulse can be shaped by the use of an open circuit delay line. The instrument can also be used as a scanning generator. (M.C.G.)

19135 CRRD-919

Atomic Energy of Canada Ltd., Chalk River, Ont.

A LARGE AND A SMALL AREA ALPHA CONTAMINATION MONITOR. A. R. Jones. Apr. 1960. 12p.

The designs are described of two alpha contamination monitors which employ transistors. Circuit diagrams, photographs of the monitors, and performance data are included. (C.H.)

19136 CRRP-931

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

SCINTILLATION COUNTERS FOR THERMAL NEUTRONS USING Li^6F AND $\text{ZnS}(\text{Ag})$. R. Stedman. May 1960. 40p. (AECL-1035). AECL.

Scintillation counters for thermal neutrons were made by molding a mixture of lucite, $\text{ZnS}(\text{Ag})$, and Li^6F . They are superior to other available gamma-insensitive scintillators for the same purpose. Detection efficiency vs. neutron energy was determined. A simple circuit to suppress fast background pulses is described. (auth)

19137 HW-35939

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

GAMMA PHOTOMETER USE FOR NONDESTRUCTIVE DETERMINATION OF URANIUM CONTENT OF ENRICHED "C" SLUGS. D. O. Richards. Mar. 23, 1955. Decl. May 4, 1960. 4p. Contract [W-31-109-Eng-52]. OTS.

Problems in the use of the γ photometer for determination of the U content of enriched slugs are outlined. Possible solutions to these problems are briefly discussed. (J.R.D.)

19138 NAA-SR-Memo-4717

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FLEXURE TESTS OF A HELICALLY COILED THERMO-COUPLE. K. H. Dearborn. Dec. 8, 1959. 4p. OTS.

Flexure tests were performed on helically coiled thermocouples composed of chromel-alumel wire, insulated with zirconium oxide or magnesium oxide, and sheathed in stainless steel. (C.J.G.)

19139 NARF-60-14T

Convair, Fort Worth, Tex.

TECHNIQUES FOR FABRICATING AN ELECTROPLATED NEUTRON THERMOPILE. C. H. Ford, R. M. Hall, and W. T. Kowalewski. June 1, 1960. 32p. Contract AF33 (600)-38946. (FZK-9-145).

The general fabrication techniques for a neutron-sensitive thermopile to be used in a reactor system as a power-level monitoring instrument are described. Techniques for fabricating and assembling the thermoelectric-coupled wires are described. Drawings and specifications of the thermopile are contained. (auth)

19140 NARF-60-15T

Convair, Fort Worth, Tex.

A LOW-NOISE PULSE PREAMPLIFIER USING SUB-MINIATURE CERAMIC TUBES. R. T. Bradbury and A. M. Morgan Voyce. Apr. 29, 1960. 24p. Contract AF33(600)-38946. (MR-N-256)

A new low-noise, wide-band, high-stability pulse amplifier was developed to take best advantage of the properties of the GE type-7077 ceramic tube. This amplifier, virtually nonmicrophonic, has a band pass of 4 mc, a rise time of 150 nsec, an output impedance of less than 20 ohms, and a gain stability of better than 1% for a 20% change in circuit parameters. (auth)

19141 NAVORD-6680

Naval Ordnance Lab., White Oak, Md.

REVIEW OF METHODS FOR MEASURING TEMPERATURES UP TO 20,000°K. Harold Hurwitz. July 6, 1959. 36p. (AD-232698).

The measurement of high temperatures is considered from the standpoint of the requirements of the Naval Ordnance Lab. high-temperature testing facilities. For temperatures of test specimens, measurements by means of the thermocouple, radiation pyrometer, and optical pyrometer are discussed. Methods considered for gas temperatures, both in combustion flames and in electric arc plasmas, include the measurement of intensities or widths of spectral lines, as well as radiance methods utilizing a comparison radiator. Among these latter, a method is proposed for using an optical pyrometer with a comparison radiator, cooler than the flame being studied. (auth)

19142 NP-8659

Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs, Colo.

DEVELOPMENT AND FABRICATION OF NON-DESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT EMPLOYING RADIATION TECHNIQUE. Monthly Progress Report for June 1959. 8p. Contract DA-19-059-501-ORD-2631. (KAC-58-92-PR-13).

Concrete blocks for the shielding caisson to be used for test purposes were fabricated. Relay matrices to the console were connected. Designs of the automatic thickness

measurement system were completed. Drawings for the automatic safety mechanism were completed. (See also KAC-58-92-Pr-1.) (C.J.G.)

19143 NP-8702

Hughes Aircraft Co. Nuclear Electronics Lab., Newport Beach, Calif. and Hughes Aircraft Co. Semiconductor Lab., Newport Beach, Calif.

THE SOLID STATE IONIZATION CHAMBER. Technical Memorandum No. 626. Stephen S. Friedland, James W. Mayer, and John S. Wiggins. Nov. 30, 1959. Reissued Jan. 8, 1960. 44p. Contract DA 49-146-KZ-016.

A solid state ionization chamber, featuring a p-n junction fused into silicon, was built. It is in use as a detector and energy spectrometer for protons, deuterons, He^3 , alpha particles, and fission fragments. The techniques required for an operational neutron detector device are discussed. The detector is suitable for fast timing techniques in the range of 10^{-10} seconds. The small size of the detector allows for its insertion into hypodermic needle, probes, or other small volumes. (W.D.M.)

19144 NP-8856

Lockheed Nuclear Products, Marietta, Ga.

MODEL IV—GRAPHITE, CARBON DIOXIDE 4-CC IONIZATION CHAMBER. C. C. Hall and S. D. Johnson. Mar. 1960. 30p. (NR-70).

The Model IV 4-cc ionization chamber, a graphite- CO_2 chamber filled with 99.99% pure CO_2 to a pressure of 30 in. Hg, was designed to withstand mechanical vibration as well as high gamma dose rates. The materials used were selected for long life in high radiation fields and for low neutron activation. To determine saturation characteristics, the ionization chamber was exposed to a gamma dose rate of 7.4×10^7 ergs/g-hr and the chamber voltage was varied from 10 to 1500 volts. The chamber was saturated at 400 volts and the ion current output remained constant from 400 to 1500 volts. The chamber was also placed in gamma fields ranging from 10^3 to 10^8 ergs/g-hr. For each gamma dose rate, the voltage required to give 90% saturation was determined. The 4-cc ion chamber was calibrated by comparing readings on it with those of a calorimeter and a Victoreen R-meter and chamber calibrated by the National Bureau of Standards. Angular response of the chamber was determined using 250-kvp x rays and radiation from the Radiation Effects Reactor. Temperature sensitivity was determined by placing the ion chamber in a water bath and controlling water temperature. (M.C.G.)

19145 SC-4422(RR)

Oklahoma State Univ., Stillwater. School of Electrical Engineering.

INVESTIGATION OF DYNAMIC CHARACTERISTICS OF RELAYS. Interim Report [for] November 1 to December 31, 1959. June 1960. 90p. For Sandia Corp. OTS.

In order to study the effects of various relay parameters on the dynamic characteristics of relays, the following five projects were done: (1) a criterion was developed for the selection of the operating voltage; (2) a method was devised in order to determine the number of shorted turns in a relay coil after the relay is assembled, based on transient coil current; (3) the effects of different coil characteristics (number of turns, resistance, and wire size) on the operating current and time were studied; (4) means of increasing the sensitivity of the influence of the armature closure bias on the delay time were studied; and (5) means of minimizing the product of the steady-state power and the pick-up time were studied. (D.L.C.)

19146 SC-4423(RR)

Oklahoma State Univ., Stillwater. School of Electrical Engineering.

INVESTIGATION OF DYNAMIC CHARACTERISTICS OF RELAYS. Final Report [for] January 26, 1959 to January 31, 1960. June 1960. 74p. For Sandia Corp. OTS.

The dynamic characteristics of sealed military-type relays were studied in order to ascertain the effects of various parameters and thus enable one to design a relay with the desired properties. The parameters were applied coil voltage and current, temperature, spring tension, contact force, contact overtravel, and mechanical clearances and were studied with reference to the magnetic flux in the relay. Recommendations are given for the improvement of relay design and adjustment. Predictable changes in spring tension and air gap were also studied. (D.L.C.)

19147 SCTM-201-60(24)

Sandia Corp., Albuquerque, N. Mex.

AN AID TO PRINTED CIRCUIT LAYOUTS USING THE IBM-704 COMPUTER. S. D. Stearns and R. A. O'Connell. June 1960. 10p. (OTS).

Possible applications and instructions for using RED-CROSS, on IBM-704 program layouts of printed circuit wiring diagrams, are discussed. (C.J.G.)

19148 SCTM-339-59(27)

Sandia Corp., Albuquerque, N. Mex.

USE OF AN AIR DEAD-WEIGHT TESTER FOR THE PRECISE CONTROL OF CONSTANT GAS PRESSURE IN CLOSED SYSTEMS. M. K. Laufer. Dec. 14, 1959. 6p. OTS.

An air dead-weight tester was used to control gas pressures when intercomparing precision gages and manometers. Constancy of controlled pressures to within 10^{-4} psi at 0.3 to 500 psi was readily attainable. A method was devised for obtaining pressures intermediate to those corresponding to discrete weights. (auth)

19149 TID-5665

Chicago. Uni. Chicago Midway Labs.

THE CHANNELED IMAGE INTENSIFIER. Seventh Quarterly Progress Report. Feb. 29, 1960. 21p. Contract AT(11-1)-647. OTS.

The new ruling engine was completed and was operated satisfactorily. Progress is reported on tube envelope and final-seal problems. (For preceding period see AECU-4627.) (W.L.H.)

19150 UCRL-5854

California. Univ., Livermore. Lawrence Radiation Lab. SOFT X-RAY DETECTION SYSTEM. Francis J. Lombard, Alexander Stripeika, and R. Stephen White. Dec. 1959. 19p. Contract W-7405-eng-48. OTS.

An evaluation is presented of a soft x ray, satellite-borne, detection system intended to detect thermal radiation from a shielded nuclear weapons test in space. A variation of the original proposal is discussed and an experimental program is presented to test its reliability. Its sensitivity is estimated as between 0.3 and 3.0 photons/ $\text{cm}^2 \mu\text{sec}$ for photon energies between 75 and 10 kev. (auth)

19151 UCRL-5977-T

California. Univ., Livermore. Lawrence Radiation Lab. A SYSTEMATIC PROCEDURE FOR PREPARING SPECIFICATIONS ON ELECTRONIC INSTRUMENTATION AND CONTROL SYSTEMS. Hyman Olken. [1960]. 60p. Contract [W-7405-eng-48]. OTS.

A systematic procedure for preparing purchase specifications on electronic instrumentation or control systems was developed. This procedure results in preparation of specifications which make it possible to find any particular specification requirement quickly and insure that no im-

portant requirement was omitted. Details of this systematic specification preparing procedure are presented. (auth)

19152 WADC-TN-59-401

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

ATTEMPT TO EVALUATE CHLORINATED HYDROCARBON DOSIMETERS BY CROSS CALIBRATING ELEVEN GAMMA RAY SOURCES. Period covered: March 1958 to November 1959. Robert L. Hickmott, Maurice J. Cote, and Philip B. Hemmig. Nov. 19, 1959. 17p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: RADIATION EFFECTS AND MEASUREMENTS. OTS.

An evaluation of the chlorinated hydrocarbon dosimetry system of Convair, Fort Worth, was attempted by the Materials Laboratory, Wright Air Development Center, with the cooperation of a number of high-intensity irradiation facilities throughout the country. The evaluation consisted of two phases. The first phase tested the precision of the dosimetry system. It involved the irradiation of thirty-five single dosimeters at WADC. The second phase was intended to field test the dosimetry system. It was also hoped that data from this phase would permit the cross calibration of the participating facilities. Data obtained in this program are presented with an analysis of the results. (auth)

19153 WADC-TR-59-711

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

OPTICALLY ACTIVE ORGANIC COMPOUNDS AS HIGH LEVEL GAMMA DOSIMETERS. [Period covered]: August 1958 to June 1959. Stanley M. Dec. Nov. 10, 1959. 38p. Project No. 7360. OTS.

Work was initiated to develop a dosimeter system which could extend the range of current dosimeter methods. A new technique was used, wherein the effects on the rotation of optically active organic compounds were determined with gamma radiation. The program was directed toward obtaining characteristics of a number of probable dosimeter systems. Linear or near linear response was observed for several systems to a range of at least 10^{10} ergs gram⁻¹ carbon. Maximum range levels were not determined since a considerable length of time is needed for irradiations at higher doses. (auth)

19154 TT-876

POSSIBLE MEASURING ERRORS IN THE VERIFICATION OF THE ROENTGEN IN OPEN AIR IONIZATION CHAMBERS. (Möglichkeiten der Fehlmessung bei der Verifizierung des Röntgen mit Frei-Luft-Ionisationskammern). E. Bunde, A. Sewkor, and D. Lang. Translated by D. A. Sinclair (National Research Council of Canada) from *Strahlentherapie* 110, 248-59(1959). 21p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 2582.

19155

ON THE SIZE DISTRIBUTION OF STARS OBSERVED IN NUCLEAR EMULSIONS. G. Bozóki and Éva Gombosi (Central Research Inst. of Physics, Budapest). *Acta Phys. Acad. Sci. Hung.* 11, 307-16(1960). (In English)

According to measurements reported by several authors, the frequency distribution of stars produced in nuclear emulsions by cosmic radiation, represented in terms of the number of their gray and black prongs, yields a curve consisting of two straight lines which intersect at a prong number N about 7.5. Upon analyzing the results of measurements on cosmic radiation and comparing them with those obtained in high-energy accelerator experiments,

it is found that the above basic feature of the frequency curve is mainly the consequence of the energy spectrum of the primary particles generating these stars. (auth)

19156

CURVATURE RADIUS MEASUREMENTS OF SHORT TRACKS IN NUCLEAR EMULSIONS. J. Catalá, F. Senent, E. Villar, R. Font, and L. Miralles (Universidad, Valencia). *Anales real soc. españ. fis. y quím.* (Madrid), Ser. A 56, 43-54(1960) Jan.-Feb. (In Spanish)

To obtain the accuracy on the average curvature radius measurements of short tracks in nuclear emulsions, a method of error calculation is described. That method was used with proton, deuteron, and alpha particle tracks. The discrimination between protons and deuterons may be carried out with an accuracy of 13/15 and 14/15, respectively. A fraction of 8/15 alpha particles can be discriminated from deuteron tracks. Further work is in progress to improve the statistics of those results. (auth)

19157

DOSIMETRY OF γ -RAYS, β -RAYS, AND NEUTRONS BY MEANS OF A $\text{CaSO}_4 \cdot \text{Mn}$ PHOSPHOR. V. A. Arkhangler'skaya, B. I. Vainberg, V. M. Kodyukov, and T. K. Razumova. *Atomnaya Energ.* 8, 559-61(1960) June. (In Russian)

Data are presented on the dosimetric properties of $\text{CaSO}_4 \cdot \text{Mn}$ and its sensitivity to γ radiation at various energies. The luminescence curves for excitation by β particles and ultraviolet, x-ray, and γ emissions are plotted as well as the magnitudes of reserved light as a function of exciting radiation. The reduced light concentration is also plotted as functions of temperature, magnitude and power of irradiation dose, and dosimeter storage. Multiple irradiation and heating does not affect its properties, and it is moisture resistant and insensitive to ultraviolet rays up to $\lambda = 1500 \text{ \AA}$. The phosphor can be used for recording thermal and fast neutrons and can be effectively utilized in individual luminescence dosimetry. (R.V.J.)

19158

STUDY OF THE NUCLEAR FIELD WITH A RIGID DISTRIBUTION OF THE CHARGE (PROTON) BY MEANS OF THE GENERAL RELATIVITY THEORY. Jean Gottlieb (Université, Iasi). *Compt. rend.* 250, 3588-90(1960) May 30. (In French)

It has been shown that the general relativity theory is applicable to electrical phenomena assuming a rigid charge distribution in order to avoid the drive forces with magnetic character. It is determined that by application of this theory to a rigid proton distribution qualitative conclusions on the interior of the nucleus can be obtained. (J.S.R.)

19159

A SIMPLIFIED β -RAY EXTRAPOLATION CHAMBER. C. T. Scarboro and L. B. Silverman (Univ. of California, Los Angeles). *Health Phys.* 2, 387-90(1960) May.

The design and calibration of an extrapolation chamber for the measurement of surface dosages emanating from β -sources are described. The unit can be used to measure dosages from β -ray plaques or other sources of various sizes and intensities. It is a versatile low-cost instrument of quite simple construction. It is designed for direct insertion into the multiple resistor turret of a commercial vibrating-reed electrometer. (auth)

19160

A HIGH-ENERGY NEUTRON-FLUX DETECTOR. J. B. McCaslin (Univ. of California, Berkeley). *Health Phys.* 2, 399-407(1960) May.

High-energy neutrons and protons in the range 20.4 Mev to more than 400 Mev can be detected in 1720-g plastic

scintillators by means of (n,2n) and (p,pn) reactions with carbon nuclei. Carbon-11 is formed which emits positrons of $E_{\max} = 0.98$ Mev and has a half life of 20.4 min. With scintillators irradiated to saturation in a neutron flux density of $1 \text{ neutron cm}^{-2} \text{ sec}^{-1}$, a subsequent 5-min waiting period and a 38-min counting time, the standard deviation in the counting statistics is less than 15 per cent. Background considerations are discussed along with some experimental and theoretical values of the (n,2n) reaction cross sections. (auth)

19161

AN ARC TYPE WATER-COOLED ION SOURCE FOR POSITIVE IONS. S. Z. R. Hashmi (Hyderabad Science Society Asifnagar, India). *Indian J. Phys.* 34, 118-22(1960) Mar.

An arc type water-cooled ion source of simple construction and reliable operation for producing positive ions is described in which the anode-filament assembly can be readily changed. The characteristic curves of the source are given. Operating at an arc current of 0.4 amp a total beam current of 500 micro-amperes is produced with a probe potential of about 3000 volts. (auth)

19162

ON THE MEASUREMENT OF THE DOSE OF GAMMA AND BETA RADIATION WITH THE AID OF THIMBLE IONIZATION CHAMBERS. V. V. Smirnov. *Izmeritel'naya Tekh.* No. 5, 47-50(1960) May. (In Russian)

The energy spectrum and angular distribution of secondary electrons was investigated using a magnetic spectrometer. Cs^{137} and Co^{60} sources were used. Targets of graphite, plexiglas, aluminum, copper, cadmium, and lead were constructed to simulate the walls of the thimble or air-wall ionization chamber. Generally, the angular distribution showed a peak in the forward direction which became more pronounced as atomic number decreased. The number of secondary electrons formed was proportional to Z/A up to values of Z approximately equal to 30 for the Cs^{137} source and 50 for the Co^{60} source. At larger values of Z the number of secondary electrons rapidly increased due to photoelectric absorption of the gamma rays. The number of secondary electrons produced in the ionization chamber as a function of the plexiglas wall thickness was investigated. The number of secondary electrons became constant at approximately 1 mm for Cs^{137} and 2.5 mm for Co^{60} . The experiments described were intended to further understanding of the processes occurring in gamma detectors. (TTT)

19163

HIGH TEMPERATURE SEMI-CONDUCTOR THERMOPAIRS. P. S. Kislyi and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Kiev). *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo*, No. 6, 135-7(1959) Nov.-Dec. (In Russian)

The technology and properties of high-temperature semiconductors of boron carbide and chromium silicide were analyzed as thermocouple material. Thermocouples of boron graphite with titanium and zirconium borides and carbides were developed for measuring temperatures in a vacuum, in reducing media, and in inert atmospheres at 2200 to 2300°C. The electromotive force characteristics were linear between 0 and 300°C and between 400 and 2300°C; nonlinearity appeared between 300 and 400°C. The means are indicated for selecting thermopairs with assigned electrical and mechanical properties and stability under given conditions. (R.V.J.)

19164

GENERAL REVIEW OF AMPLIFIERS AND OF THEIR USES IN NUCLEAR PHYSICS. Jaromir Vicha (CZAV Nuclear Re-

search Establishment, Prague). *Jaderná energie* 6, 125-6 (1960). (In Czech.)

The function of pulse amplifiers in experimental nuclear physics is reviewed, paying special attention to the desirable characteristics and comparing them with 3 typical commercial linear amplifiers, a preamplifier, and a wide band amplifier. For linear amplifiers, positive and negative output impulses were listed for the polarity. One linear amplifier had provisions on the control panel for tapping off its amplification in three stages. The instruments are designed as self-contained units suitable for vertical panel mounting. Circuit diagrams are not included. (TTT)

19165

RADIOACTIVE GAGES FOR AIR-COOLED TURBINE BLADES. I. LIQUID-SOURCE GAGE FOR HOLLOW BLADES AND VANES. William J. Mayer and Walter H. Lange (General Motors Corp., Warren, Mich.) and William L. Shelly (General Motors Corp., Indianapolis). II. SCANNING BETA GAGE FOR COOLING-CHANNEL WALLS. Herbert E. Farmer (General Electric Co., Lynn, Mass.). *Nucleonics* 18, No. 7, 64-8(1960) July.

Two methods are developed for measuring the thickness of turbine blade surfaces which are air-cooled by hollow spaces and drilled passages. I. Liquid-source Gage for Hollow Blades and Vanes. The specimen is filled with a solution of a gamma-emitting nuclide, Sm^{153} , and the gamma radiation is measured on the other side with a G-M counter. In this way, core shifts which have taken place in casting can be detected. Calibration curves are given. II. Scanning Beta Gage for Cooling-channel Walls. After a blade is clamped, a radioactive probe and a detector are moved toward it, the probe passing into it and the detector under it. The probe is a hollow stainless steel needle containing Sr^{90} - Y^{90} . The accuracy (95% confidence limit) is ± 2 to 3 mils in the thickness range 20 to 41 mils. Calibration curves are given. (D.L.C.)

19166

TRANSISTOR AMPLIFIER FOR FAST PROPORTIONAL COUNTING. John B. S. Waugh and Roy W. Nicholson (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Nucleonics* 18, No. 7, 70; 72-4(1960) July.

A transistor amplifier is developed which has counting rate plateaus over 200 volts long with slopes less than 0.2% per 100 volts, and it should be useful for measuring total source activity in 4π beta flow counters. The circuit is given in detail. The detection sensitivity is estimated to be about 20 ion pairs in the primary ionizing event. (D.L.C.)

19167

MEASUREMENTS OF GAMMA-RAY DOSES OF DIFFERENT RADIOISOTOPES BY THE TEST-FILM METHOD. Józef Domanus and Leszek Halski (Institut für Elektrotechnik, Warsaw). *Nukleonika* 5, 227-38(1960). (In German)

The test-film method seems to be most suitable for systematic, periodical measurements of individual doses of ionizing radiation. Persons handling radioisotopes are irradiated with gamma rays of different energies. The energy of gamma radiation lies within much broader limits than is the case with x rays. Therefore it was necessary to check whether the test-film method is suitable for measuring doses of gamma-rays of such different energies and to choose the proper combination of film and screen to reach the necessary measuring range. Polish films, Foton Rentgen and Foton Rentgen Super and films from the German Democratic Republic, Agfa Texo R and Agfa Texo S were tested. Expositions were made without

intensifying screens as well as with lead and fluorescent screens. The investigations showed that for dosimetric purposes the Foton Rentgen Super films are most suitable. However, not one of the film-screen combinations gave satisfactory results for radioisotopes with radiation of different energies. In such a case the test-film method gives only approximate results. If, on the contrary, gamma energies do not differ greatly, the test-film method proves to be quite good. (auth)

19168

COINCIDENCE SCHEMES IN NUCLEAR PHYSICS. A. V. Kutsenko (Inst. of Physics, Academy of Sciences, USSR). Pribery i Tekh. Ekspt. No. 1, 3-16(1960) Jan.-Feb. (In Russian)

A review is given of the coincidence schemes applied in nuclear physics. Their basic parameters, working principle, classifications, and characteristics are compared. (tr-auth)

19169

CHERENKOV SPECTROMETER FOR MEASURING GAMMA-QUANTA. V. S. Pantuev, M. N. Khachatryan, and I. V. Chuvilo (Joint Inst. of Nuclear Research, [Dubna, USSR]). Pribery i Tekh. Ekspt. No. 1, 19-22(1960) Jan.-Feb. (In Russian)

Descriptions are given of a Cherenkov spectrometer designed for measuring γ energies from 100 Mev up to several Bev. The γ quantum creates an electron-photon shower in a lead-glass radiator which absorbs part of the energy. The amount of Cherenkov luminescence emitted by the charged component is taken as the initial γ energy. The spectrum was tested and calibrated with monoenergetic electrons at 100 to 230 Mev. The energy resolution of the spectrometer at 200 Mev is $\pm 40\%$. The spectrometer is 100% efficient and is linear in the examined range of energies. (tr-auth)

19170

CONSTRUCTION OF MAGNETIC SPECTROMETER FOR DETECTION OF ELECTRON ANGULAR DISTRIBUTIONS. V. V. Smirnov (Radium Inst., Academy of Sciences, USSR). Pribery i Tekh. Ekspt. No. 1, 22-4(1960) Jan.-Feb. (In Russian)

A design is given for a magnetic spectrometer used for determining energy and angular electron distributions in the range of 0.02 to several Mev at 0 to 180°. Angular distributions and energy spectra of secondary electrons knocked from thick targets by Cs^{137} and Co^{60} and electron spectra scattered in reverse under various angles from W^{185} , Y^{91} , and P^{32} are studied. (R.V.J.)

19171

SCINTILLATION SPECTROMETER FOR FAST NEUTRONS. A. G. Khabakhpashev. Pribery i Tekh. Ekspt. No. 1, 25-9 (1960) Jan.-Feb. (In Russian)

The spectrometer was designed for measuring the spectrum of recoil protons from neutrons scattered at a given energy. The scattered neutrons are discriminated by time-of-flight characteristics. Results of Po-Be source spectrum measurements are included. The highly efficient instrument is capable of measuring sources of $\sim 200,000$ neutrons/sec intensity. (tr-auth)

19172

GAS DISCHARGE COUNTERS WITH LARGE PULSE OVERPOTENTIAL. B. A. Dolgoshein, B. I. Luchkov, and V. I. Ushakov. Pribery i Tekh. Ekspt. No. 1, 39-42(1960) Jan.-Feb. (In Russian)

The properties of MS-9, GS, and GS-30 counters operating with controlled pulse supply were investigated. The

memory as a function of pulse supply is analyzed. A simple method is given for measuring the rate of charge distribution along the counter filament. (tr-auth)

19173

ANALYZER FOR TIME MEASUREMENTS WITH SPARK COUNTERS. L. I. Artemenkov and M. V. Babykin. Pribery i Tekh. Ekspt. No. 1, 43-7(1960) Jan.-Feb. (In Russian)

The construction of an analyzer based on the time interval expansion and transformation into amplitudes is described. The time resolution of the apparatus at half-height after several hours of operation is $2\tau = 5 \times 10^{-11}$ sec. The resolution of the coincidence curve for spark counters at electrode distance $\delta = 0.15$ mm is $2\tau = 1.7 \times 10^{-10}$ sec. (tr-auth)

19174

NON-OVERLOADING AMPLIFIER WITH IMPROVED PULSE-TIME INCREMENT. A. N. Pisarevskii and Yu. E. Selyaninov (Radium Inst., Academy of Sciences, USSR). Pribery i Tekh. Ekspt. No. 1, 63(1960) Jan.-Feb. (In Russian)

Descriptions are given of a linear nonoverloading amplifier with improved pulsetime increment. The basic parameters of the amplifier are: pulse-time increment at output of 10 to 90 sec, 5×10^{-8} ; amplification factor, 10^3 ; overload factor, ~ 200 ; maximum signal at linear output of 1%, 120 v; and nonoverload point, ~ 20 v (for both polarities). The instrument consumes 160 ma from a +300 v source and 35 ma from -250 v. (R.V.J.)

19175

ELECTRON TUBES FOR OSCILLOGRAPHS WITH MECHANICAL SCANNING. V. M. Vyrodov and T. V. Pogorelova. Pribery i Tekh. Ekspt. No. 1, 65-6(1960) Jan.-Feb. (In Russian)

The design and performance of electron tubes for oscillographs with mechanical scanning are presented. (R.V.J.)

19176

MEASUREMENTS OF ELECTRON TIME OF FLIGHT IN PHOTOMULTIPLIERS. V. M. Gorbachev, L. D. Usenko, and N. A. Uvarov. Pribery i Tekh. Ekspt. No. 1, 69-73 (1960) Jan.-Feb. (In Russian)

Electron time-of-flight was measured in four types of photomultipliers. The measurements used the method of controlled electron flux and the "spark" method. The data are described by a semi-empirical formula. The order of accuracy is $(4 \text{ to } 5) \times 10^{-9}$ sec. The suggested controlled electron flux method is also used for investigating photomultiplier pulse characteristics. (tr-auth)

19177

MAGNETIC FIELD INDEX MEASUREMENTS WITH OSCILLATING COIL. L. Shippek (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Pribery i Tekh. Ekspt. No. 1, 74-8(1960) Jan.-Feb. (In Russian)

A device with a coil oscillating along the helical trajectory of the measured field is applied for measuring constant magnetic field index. The relative order of accuracy is 1% for indexes > 0.3 and $\sim 2\%$ for ~ 0.1 v $5/m^2$ fields. (tr-auth)

19178

HETEROGENEOUS MAGNETIC FIELD INTENSITY AND GRADIENT MEASUREMENTS BY NUCLEAR MAGNETOMETERS. Yu. N. Denisov (Joint Inst. of Nuclear Research, [Dubna, USSR]). Pribery i Tekh. Ekspt. No. 1, 82-4(1960) Jan.-Feb. (In Russian)

Nuclear magnetometer transducers capable of highly accurate measurements of the intensity and gradient of very heterogeneous magnetic fields are described. The permissible magnetic field heterogeneity is 1000 to 1200 e/cm. The order of accuracy is 0.01% for absolute magnetic field intensity and 0.5 to 1% for the gradient. The direction of the gradient in magnetic fields of arbitrary configuration may also be determined. (tr-auth)

19179

HIGH CURRENT PULSE GENERATOR. V. M. Kul'gavchuk and N. A. Protopopov. Pribery i Tekh. Ekspt. No. 1, 85-9 (1960) Jan.-Feb. (In Russian)

A high-current pulse generator using long discharges is described. The generator is capable of developing current pulses up to 250 ka of 0.3 μ sec duration with a maximum increment of 3×10^{12} a/sec. A special separator is used for pulse intensities up to ~ 100 kv. (tr-auth)

19180

ELECTROMAGNET FOR PHYSICO-CHEMICAL STUDIES. I. M. Puzel and P. G. Sabinin (Central Scientific-Research Inst. of Ferrous Metallurgy). Pribery i Tekh. Ekspt. No. 1, 104-9(1960) Jan.-Feb. (In Russian)

Calculations and construction are presented of a 3.5-ton electromagnet which rotates around a vertical axis. (R.V.J.)

19181

TRACING OF PARTICLE TRACKS IN EMULSION STACKS. D. S. Amankulova, V. F. Vishnevskii, N. G. Zabudkina, and E. V. Ashlagina (Inst. of Nuclear Physics, Academy of Sciences, Kazakh, SSR). Pribery i Tekh. Ekspt. No. 1, 112-13(1960) Jan.-Feb. (In Russian)

A method is suggested for a speedy and accurate tracing of particle tracks in emulsion stacks. (R.V.J.)

19182

ON THE FORMATION OF IMAGES IN TRACK PHOTOGRAPHY IN BUBBLE CHAMBERS. Yu. A. Alexandrov, V. M. Gorbunkov, N. B. Delone, and V. M. Likhachev (Inst. of Physics, Academy of Sciences, USSR). Pribery i Tekh. Ekspt. No. 1, 113-14(1960) Jan.-Feb. (In Russian)

Large-scale pictures of electron tracks in propane bubble chambers, illuminated by various light sources, confirm the postulation that in particle track photography the bubbles record the illumination source. The displacement of the illumination source image is considerable in relation to the bubble centers (for liquid hydrogen it is $f^1 \approx 6R$ of the bubble) producing various effects depending on the geometry of the illumination and chamber construction. (R.V.J.)

19183

PRECISION TEMPERATURE MEASUREMENT OUTSIDE THE LABORATORY. W. H. P. Leslie, J. J. Hunter, and D. Robb (National Engineering Lab., East Kilbride, [Eng.]). Research (London) 13, 250-6(1960) July.

Existing resistance-thermometer techniques of millidegree accuracy were originated by Callendar in the 1890's. To meet the problem of measuring with this accuracy in field tests, new robust thermometers and the use of transformer ratio-arm bridges are proposed. Three methods for the elimination of the effect of long leads to the thermometers are suggested. Two of these were not possible with the bridge methods at present favored in other laboratories. Limited tests show sufficient promise to merit investigation and to suggest that a reconsideration of the techniques used for resistance-thermometer bridges is due. Bridges suitable for strain gage and differential transformer use are described. (auth)

19184

DETERMINATION OF THE TEMPERATURE DENSITY GRADIENT THROUGH THE ABSORPTION OF PENETRATING RADIATION. L. G. Berezkina and A. M. Yakobson (Inst. of Metallurgy, Academy of Sciences, USSR). Zavodskaya Lab. 26, 171-2(1960). (In Russian)

The use of relative gamma intensities to determine the temperature density gradient, $\Delta\rho/\Delta t$, of molten substances at high temperatures was tested. Using zirconium crucibles, the method was verified by determining the value of $\Delta\rho/\Delta t$ for tin. The gradients for molten $4\text{PbO} \cdot \text{SiO}_2$, $2\text{PbO} \cdot \text{SiO}_2$, and $\text{PbO} \cdot \text{SiO}_2$ were then determined by this method to be $0.103 \cdot 10^{-2}$, $0.090 \cdot 10^{-2}$, and $0.071 \cdot 10^{-2}$ g/cm 3 C, respectively. This method makes possible the single sample determination of the relative change of density with temperature during crystallization and subsequent cooling of a molten substance, and the effect of cooling rate on the density of the solid phase. (TTT)

19185

THE MEASUREMENT OF RADIOACTIVITY IN A LIQUID BY MEANS OF SCINTILLATION COUNTERS. A. I. Nisnevich (Tractor Research Inst., USSR). Zavodskaya Lab. 26, 175-7(1960). (In Russian)

The temperature effect on the sensitivity of a scintillation counter must be accurately determined when using continuous counting methods to determine the rates of wear of lubricated machine parts at high temperatures. The introduction of pulse amplitude discriminators may reduce this temperature effect, but the maintenance of near constant scintillation crystal temperatures is the most satisfactory method of maintaining linearity between counting rate and wear rate. An arrangement for measuring the radioactivity in lubricating oil with crystal temperature maintained nearly constant is described, and a typical graph of count rate versus time for a test of a diesel engine having radioactive piston rings is given. (TTT)

19186

A BETA-COUNTING METER FOR POTASSIUM SALT SOLUTIONS. I. V. Vagner, A. I. Novosel'skaya, and L. P. Titarenko (Automation Inst., State Planning Commission, USSR). Zavodskaya Lab. 26, 342-4(1960). (In Russian)

An instrument has been developed that in 15 to 20 minutes determines the concentration of potassium salts in a solution to an accuracy of 1%. The instrument counts beta particles emitted by the K^{40} isotope. The low specific activity of K^{40} is overcome by utilizing ten counter tubes in parallel. The relationship between weight concentration and count rate is linear for the solutions tested, and is only slightly nonlinear for volume concentration. It is essential to register 4000 counts in order to achieve 1% accuracy. It takes 15 minutes to accumulate this number of counts in the case of a 20% solution of KCl. The instrument must be carefully calibrated with standard solutions. (TTT)

19187

A SEARCH FOR ALLOYS SUITABLE FOR HIGH-TEMPERATURES THERMOCOUPLES. A. A. Rudnitskii and I. I. Tyurin. Zhur. Neorg. Khim. 5, 401-9(1960) Feb. (In Russian)

The prime requirement of a high-temperature thermocouple is stability of voltage reading at as high a temperature as possible. Thus, for temperatures from 1300 to 1600°C a Pt-PtRh couple can be used, but the readings are stable only up to 1300°C. The refractory metals tungsten and molybdenum are used to measure temperatures up to 2000°C, but these suffer from the disadvantage that they are readily oxidized in air. Alloys of the noble metals are the most stable to oxidizing conditions at high temperatures.

The principal reasons for variations in voltage readings are oxidation of the alloy, volatility of the metal, diffusion at the hot junction, and chemical reaction with the surrounding medium or insulation. Thus, ruthenium and iridium form stable oxides which have a relatively high vapor pressure. The problem of diffusion can be minimized by using different contents of the metal in both junctions. The thermocouples (Pt + 30% Rh)-(Pt + 6% Rh) and Rh-(Pt + 20% Rh) show low voltage readings at the lower temperatures (0 to 600°C), but this characteristic is an advantage in high temperature work since the cold junction need not be kept at a constant temperature. A variation in temperature of the cold junction from 0 to 200°C will introduce an error of only about 1% in measuring a temperature of 1800°C. The calibration for the thermocouple Ir-(Ir + 60% Rh) is practically linear at high temperatures. The melting point of this thermocouple is about 2340°C. The stability of the voltage reading of various thermocouples at high temperatures was investigated. A change in temperature reading of 1% at 1550°C was shown by the thermocouple Pt-(Pt + 10% Rh) after 75 hours operations, by (Pt + 30% Rh)-(Pt + 6% Rh) after 230 hours operation and by Rh-(Pt + 20% Rh) after 1500 hours. Tests at 1800°C showed that the thermocouple Rh-(Pt + 20% Rh) operated for 100 hours with a change in voltage of $\pm 0.5\%$, when special pains were taken to exclude silica from the insulator by substituting aluminum or beryllium oxides. It is evident that the diffusion of platinum into the rhodium is of no consequence. The thermocouple (Ir + 60% Rh)-Ir showed signs of recrystallization after operation at 1800°C for 25 hours that resulted in an increase of voltage of 0.6%. Subsequent voltage changes did not exceed $\pm 0.3\%$. The replacement of pure rhodium in the thermocouple Rh-(Pt + 20% Rh) by alloys of platinum and rhodium containing some iridium, palladium or ruthenium was unsatisfactory, since these combinations were less stable. The specific electrical resistances of Rh, Ir, Pt + 20% Rh and Pt + 20% Rh + 10% Ir were determined as a function of temperature. The prime advantage of the noble metal alloys is their resistance to oxidation. (TTT)

19188

THERMOGRAPHIC ANALYSIS OF SALTS WITH SIMULTANEOUS DETERMINATION OF TEMPERATURE EFFECTS AND ELECTRICAL CONDUCTIVITY. L. G. Berg and N. P. Burmistrova. *Zhur. Neorg. Khim.* 5, 676-83 (1960) Mar. (In Russian)

An apparatus is described which continuously records temperature (t^0), the difference in temperature (Δt^0), and the change in electric conductivity (χ). Fusion of a pure salt leads to a sharp jump in electric conductivity, but polymorphic transformations of one form of solid to another form show little change in electric conductivity for salts such as KNO_3 , Na_2SO_4 , NH_4NO_3 , and others. Thus, NH_4NO_3 shows three polymorphic transformations at 34, 80, and 125°C with the absorption of heat, but a sharp increase in electric conductivity takes place only at the point of fusion (168°C). A mixture of sodium sulfate with some potassium chromate added as an impurity shows a gradual rise in electric conductivity starting at 650°C and reaching a maximum at the point of fusion (884°C). After purification of the Na_2SO_4 salt by recrystallization, the sharp rise in electric conductivity takes place right at the point of fusion. Thus, this method can be used to verify the purity of a salt. The formation of a relatively low-melting eutectic can readily be detected in complicated multi-component systems. Dehydration and fusion processes with accompanying endothermal and exothermal effects are readily apparent. It was found that solid phase

reactions are accompanied by a sharp rise in electric conductivity which points to the importance of the formation of a liquid phase as an intermediate stage preceding the occurrence of a solid phase reaction. The formation of a liquid phase was checked by observation under a microscope. The simultaneous determination of thermal effects and electric resistance can serve as a powerful tool in elucidating the mechanism of solid phase reactions. (TTT)

19189

ABSOLUTE MEASUREMENTS OF THE INTENSITY OF THE HIGH ENERGY γ -RAY BY MEANS OF PAIR DIFFERENCE METHOD. I. N. Usova (Lebedev Inst. of Physics, Moscow). *Zhur. Tekh. Fiz.* 30, 665-71 (1960) June. (In Russian)

The absolute measurements of synchrotron ($W_{\text{max}} = 260$ Mev) bremsstrahlung intensity by the method of pair differences (lead and aluminum, lead and copper, and copper and aluminum) exceeded twice the magnitudes obtained by means of a thick graphite chamber. The discrepancy is caused by disregard of the photoeffect influence and by the multiple electron scattering in converters during measurement by the method of pair difference. The magnitudes obtained by both methods, within 10%, coincide when the above effects are taken into account. (tr-auth)

19190

IMPROVEMENTS IN OR RELATING TO GAS-FILLED ELECTRIC CABLES. Bernard Frederick Salvage (to W. T. Henley's Telegraph Works Co., Ltd.). British Patent 834,536. May 11, 1960.

A gas-filled electric cable that operates at very high voltages is described. The cable consists of a conductor and a dielectric. The dielectric is formed of polyethylene tape modified by high-energy radiation to produce a cross-linked structure. (W.L.H.)

19191

DEVICE FOR RECORDING THE INCIDENCE OF RADIATION DUE TO AN ATOMIC EXPLOSION. Philip Henry Wagner (to General Radiological Ltd.). British Patent 835,994. June 1, 1960.

A device is described for determining the direction of electromagnetic radiation produced by the explosion of an atomic bomb. The device consists of an opaque container the wall of which is a simple surface of revolution. The wall has a sensitized blank lining and is wholly enclosed by the container. Both blank and container have perforations spaced in azimuth around the container each admitting radiation to the blank over a limited angular range in azimuth bordering on or preferably overlapping the ranges of admission of neighboring openings. (W.L.H.)

19192

MULTIPLE SPARK GAP SWITCH. (to U. S. Atomic Energy Commission). British Patent 836,745. June 9, 1960.

A high-voltage high-current spark gap switch is presented. The switch is composed of a planar electrode having a plurality of protuberances of convex shape on the surface. A firing electrode is insulatingly supported in each of the electrode protuberances and extends to the apex. A dielectric plate is supported parallel to the electrode, and the plate has a plurality of individual electrodes. Each of the individual electrodes is arranged in opposition to one of the protuberances. Terminal connecting means are affixed to the electrode and to each of the individual electrodes. (W.L.H.)

19193

IMPROVEMENTS IN OR RELATING TO PROCESSES FOR

DETERMINING THE DOSAGE OF X AND GAMMA RADIATIONS. Norbert Jean-Marie Pierre-Francois Chassende-Baroz. British Patent 836,804. June 9, 1960.

A photographic emulsion is presented for measuring the dosage of x and γ radiation within a range from 100 to several hundred roentgens. The emulsion is of the silver halide ammoniacal type incorporating a desensitizing agent to lower the emulsion sensitivity and make it capable of differentiating exposures within the given range. (W.L.H.)

Materials Testing

19194 DP-243

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

EDDY CURRENT DETECTION OF Al-Si PENETRATIONS IN CANNED SLUGS. Richard C. Robinson and John D. Ross. Dec. 1957. Decl. May 4, 1960. 14p. Contract AT(07-2)-1. OTS.

An instrument for detecting Al-Si alloy penetrations in the Al jacket of fuel slugs is described. The instrument is of the eddy current type, and the sensing element is a small probe that does not touch the specimen under inspection. Al-Si inclusions 0.020 in. in diameter that penetrate to within 0.005 in. of the can surface can be detected. The response of the circuits is such that a slug 8 in. long can be scanned in 45 sec. (auth)

19195 SUDAER-83

Stanford Univ., Calif.

MECHANICS APPLIED TO CREEP TESTING—WILLIAM M. MURRAY LECTURE. N. J. Hoff. Dec. 1958. 88p. Contract AF49(638)-223. (AFOSR-TN-59-39).

Paper presented before the Society for Experimental Stress Analysis in Albany, N. Y., on November 13, 1958.

The effects of the nonlinearity of creep laws on the results of creep tests and predictions of the effects of small changes in parameter on strain rates were studied. A review was made of empirical creep laws. Some of the causes of scatter in creep test results were found to be inaccuracies in average values of variables, fluctuations of stress and temperature, and changes in geometry. Stress distributions in the presence of secondary creep, interactions between elasticity and steady creep, possible causes of primary creep, and instabilities were also studied. (M.C.G.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

19196 CEA-Note-288

[France. Commissariat à l'Énergie Atomique]. Direction des Recherches et Exploitations Minières, [Chatillon]. **QUELQUES PROGRES DANS LA REALISATION DES APPAREILS DE PROSPECTION RADIOMETRIQUE ET LEURS APPLICATIONS.** (Progress in Construction of Radiometric Prospecting Apparatus and Its Applications). J. Berbezier and M. Lesueur. 1959. 15p.

A survey is made of transistorized radioprospecting instruments used by CEA. A gammaphone, the GMT-14 Gammameter, a mine gammameter, a 20-mm diam. radio-core sonde, and two scintillometers are described. (T.R.H.)

19197 NP-8827

Lockheed Nuclear Products, Marietta, Ga.

AIR TRACER EXPERIMENTS AT GEORGIA NUCLEAR LABORATORIES. R. M. Boyd. Feb. 1960. 28p. Contract AF33(600)-38947. (NR-83).

Under nighttime inversion conditions, submicroscopic silver iodide particles were generated in a valley of 300-ft depth and were traced by portable cold chambers. Concentrations were observed two miles down valley from the generator site; it appeared that most of the particles did not rise higher than 200 ft under a strong, low-level temperature inversion. It is concluded that silver iodide particles can be used to simulate the movement of a gas in the lower atmosphere. (auth)

19198 TEI-765

Geological Survey, Washington, D. C.

THERMOLUMINESCENCE OF SOME DOLOMITE, TUFF, AND GRANITIC ROCK SAMPLES FROM THE NORTH-CENTRAL PART OF THE NEVADA TEST SITE, NYE COUNTY, NEVADA—A PROGRESS REPORT. D. D. Dickey. July 1960. 30p. OTS.

Thermoluminescence was determined for tuff from Rainier Mesa, dolomite and a quartz vein from Dolomite Hill, and granitic rock from the climax stock in the northern part of the Nevada Test Site, Nye County, Nev. The study was made to determine which rocks are thermoluminescent, to explore the possibility of using thermoluminescence as an aid in correlating stratigraphic units, and to acquire the background information necessary to determine the usefulness of thermoluminescence in detecting or measuring some of the effects on rocks of nearby underground nuclear explosions. The results of the study showed that dolomite, granite rocks, and tuff are thermoluminescent. (W.L.H.)

19199 TEM-836-B

Geological Survey, Washington, D. C.

"GRANITE" EXPLORATION HOLE, AREA 15, NEVADA TEST SITE, NYE COUNTY, NEVADA—INTERIM REPORT, PART B, HYDROLOGIC DATA. C. E. Price. Nov. 1959. 21p. OTS.

Observations of fluid-loss during drilling and measurements of water-level recovery after bailing and of decline after water injection indicate two zones in the granite that are more permeable than the rest of the rock. The hole is entirely above the regional water table. Circulation of air through the hole suggests fairly extensive unsaturated openings between 1,175 and 1,200 feet. (auth)

19200 TID-6095

Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.

FINAL REPORT [ON RADIO-GEOLOGY]. Wallace S. Broecker. June 1, 1960. 39p. Contract AT(30-1)-2364. OTS.

Work reported may be divided into three parts: (1) Ra^{226} — U^{238} age determinations on marine shells, (2) geochemistry of Th^{230} in deep sea cores, and (3) geochemistry of uranium, thorium, and their respective daughter products in fresh water systems. Application was made of the ionium method for determining the age of carbonates in the marine shells. Analyses of deep sea cores were made for carbon and thorium isotopes. The C^{14} method was used to date these cores to approximately 40,000 years. Measurements are being conducted for Th^{230} , Th^{227} , and Pa^{231} to provide methods for determining ages to ~100,000 years. Methods for determining ages of fresh water carbonates were studied from analyses of the abundance of uranium, thorium, and their decay products in fresh water systems. (B.O.G.)

19201 UCRL-5949

California. Univ., Livermore. Lawrence Radiation Lab. **AN APPLICATION OF NUCLEAR EXPLOSIVES TO BLOCK CAVING MINING.** W. G. Flangas and L. E. Shaffer. June 2, 1960. 23p. Contract W-7405-eng-48. OTS.

Drilling and mining explorations at the site of the Rainier event (detonated at the Nevada Test Site of the AEC) have revealed that it is possible to mine back into the area of a nuclear explosion by the use of commonly accepted mining methods. Therefore, it also appears possible to apply nuclear explosives in preparation for mining by a modified block-caving technique. (auth)

19202 JPRS-2752

LITERATURE ON METEOROLOGY, HYDROLOGY AND OCEANOGRAPHY IN 1959. Translated from *Meteorol. i Gidrol.*, No. 4, 56-60(1960). 11p. OTS.

This bibliography contains information on the hydro-meteorological literature published in Russian during 1959. (W.L.H.)

19203

CARBON-13 IN LAKE WATERS, AND ITS POSSIBLE BEARING ON PALEOLIMNOLOGY. Shinya Oana and Edward S. Deevey. *Am. J. Sci.* 258-A, 253-72(1960).

Surface waters of dimictic lakes in Connecticut have an average δC^{13} of -8.6% , but the hypolimnion is more depleted ($\delta C^{13} \geq -22.6\%$). Seston, mud, and mollusc flesh average ca. -30% , but submerged pondweeds are richer. Four sources, partly evaluable from C^{13} ratios, can contribute to hypolimnetic CO_2 : (a) surface CO_2 ($\delta C^{13} \sim -9\%$), inherited from circulation; (b) respiratory CO_2 ($\delta C^{13} \sim -30\%$) from oxidation of seston; (c) fermentation CO_2 ($\delta C^{13} \sim -5\%$), here shown to be enriched at the expense of CH_4 ($\delta C^{13} \sim -70\%$); (d) carbonate CO_2 ($\delta C^{13} \sim 0\%$), important in hard waters. Metabolism = $b + c$; and d , both heavy, can be separated by C^{14} assay. In Quassapaug (softest), where d is negligible, c represents 4 to 20% of total metabolism. In Queechy (hardest), d could account for all heavy CO_2 . In Linsley Pond (medium-hard), after allowance for d , c appears to provide 40% of total metabolism. Discovery that fermentation CO_2 is heavy raises important questions about ground water. Applied to paleolimnology, C^{13} assay may be ambiguous for the same reason: fermentation tends to raise ratios lowered by aerobic metabolism. In one meromictic lake in a humid region, permanent stagnation has not produced fractionation, presumably because of c ; owing to dominance of d , a meromictic saline lake also fails to show fractionation. The earliest organic deposits of the last Pleistocene Searles Lake are enriched in C^{13} , presumably because the lake redissolved much carbonate, and the C^{13} ratio fell only gradually. In the middle Huronian Fe-banded cherts of Michigan, the $FeCO_3$ rich layers may be poorer in C^{13} than the SiO_2 -rich layers, and the depletion of these siderites supports the lacustrine hypothesis. (*GeoSci. Abstr.* 2, No. 6, 1959)

19204

THE γ -RAY SPECTRA RESULTING FROM NEUTRON CAPTURE IN CERTAIN ROCKS. A. A. Fedorov, M. M. Sokolov, and A. P. Ochkur. *Atomnaya Energ.* 8, 555-6 (1960) June. (In Russian)

An analysis is made of the γ spectra from neutron irradiation of hornstones and diorites. The results confirm the feasibility of determining various chemical elements in rock by radiative neutron capture. The thermal neutron capture cross sections and energy of principle γ lines ($E_\gamma = 4.5$ Mev) for the above rocks are plotted. (R.V.J.)

19205

U^{235} EXCESS IN MAGNETITE WITH A HIGH ACTINIUM CONTENT. V. V. Cherdyn'tsev, E. A. Isabaev, Yu. A. Surkov, D. P. Orlov, and Z. P. Usatov (Kirov State Univ. and Verradskii Inst. of Geochemistry and Analytical Chem-

istry, Moscow). *Geokhimiya* No. 4, 373-4(1960). (In Russian)

An excessive U^{235} content was detected in magnetite which also contains excessive actinium. It is supposed that both effects are conditioned by the complicated spontaneous decay of a transuranium emitter, little amounts of which yet exist in nature. (auth)

19206

THE ELECTROCHEMICAL MECHANISM OF SULFIDE SELF-POTENTIALS. Motoaki Sato (Harvard Univ., Cambridge, Mass.) and Harold M. Mooney (Univ. of Minnesota, Minneapolis). *Geophysics* 25, No. 1, 226-49(1960) Feb.

Self-potentials associated with a sulfide ore body result from the ohmic potential drop within the country rocks. The electric current is produced by separate but simultaneous reduction of oxidizing agents near the surface and oxidation of reducing agents at depth. The ore does not participate directly in either reaction, but serves as a conductor to transfer the electrons from the reducing agents to the oxidizing agents. The possibility for the above reactions to occur depends upon differences in oxidation potential of ground waters at different depths. In the zone of weathering, the oxidation potential is controlled by the reduction mechanism of oxygen, and ranges in value from 0.2 to 0.7 volt (on the hydrogen scale). If the ore tends to oxidize at some lower potential, then the latter is the available one. In the zone beneath the water table, the potential is probably controlled by the oxidation-reduction equilibria of iron-rich minerals, and ranges in value from 0 to -0.3 volt. The available potential is independent of ore type. The maximum potential difference available to produce natural currents is estimated at: graphite 0.8, pyrite 0.7, covellite 0.6, chalcocite 0.5, galena 0.3 volt. Self-potentials will be large if the ore body (1) is composed of minerals difficult to oxidize, (2) has low electrical resistance (physical continuity together with low resistivity), (3) extends vertically across the water table, and (4) exists close to the surface. (auth)

19207

SPATIAL AND TIME FLUCTUATIONS OF NATURAL ATMOSPHERIC RADIOACTIVITY. S. G. Malokhov, G. S. Kirdin, A. V. Kovda, and T. I. Sisigina (Inst. of Applied Geophysics, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz.* No. 5, 698-706(1960) May. (In Russian)

Measurements were made of the natural radioactivity close to the ground at nine geographic points resulting from variable radioactive emanations from the soil. The mean values and the maxima are given for radon and its decay products and for the γ field intensity. Parallel measurements of natural reactivity and vertical turbulent mixing factors were carried out and the results correlated. The influence of certain meteorological factors on fluctuations in natural radiation and on the daily concentrations of Rn and its decay products near the ground is analyzed. (R.V.J.)

19208

ON THE STRATOSPHERIC FALLOUT OF STRONTIUM-90: THE SPRING PEAK OF 1959. L. M. Fry, F. A. Jew, and P. K. Kuroda (Univ. of Arkansas, Fayetteville). *J. Geophys. Research* 65, 2061-6(1960) July.

A pronounced peak in the rates of stratospheric fall-out of Sr^{89} and Sr^{90} was observed at Fayetteville, Arkansas, during the spring months of 1959. A large increase of the stratospheric Sr^{90} inventory due to the fall 1958 test series was indicated. The changing ratios of isotopes in fall-out

indicate that it is unlikely that the spring peaks are attributable solely to high-yield Soviet autumn tests. (auth)

19209

A CHEMICAL CORRECTION FACTOR IN GAMMA-GAMMA DENSITY LOGGING. Z. F. Danes (Boeing Airplane Co., Seattle). *J. Geophys. Research* **65**, 2149-53 (1960) July.

Log-derived rock densities may be in error for two reasons: first, the ratio of A/Z varies for different chemical elements; second, the photoelectric absorption, neglected in calibration, may become appreciable if heavier elements are present. The effects are discussed and the A/Z correction factors calculated. (auth)

19210

NUCLEAR LOGGING IN THE APPLACHIAN BASIN. R. M. MacFarlane and R. K. Ault. *Kentucky Geol. Survey* (10) Spec. Publ. No. 2, 13-27 (1959).

Gamma ray-neutron logs are used for porosity determination under various bore hole conditions. The gamma ray log is used to correct the neutron response so that true porosity (effective) can be determined. The combination gamma ray-dual spaced neutron logs were successful in detecting gas-bearing formations in wet or dry cased and uncased bore holes. The dual spaced neutron log is also used in differentiating between liquid filled porosity and gas filled porosity. This combination of logs does not indicate formations as gas bearing in the case where invasion of bore hole liquid is greater than the depth of investigation of the neutron device. (*GeoSci. Abstr.* **2**, No. 6, 1960)

19211

GEOLOGY OF THE ROSS-ADAMS URANIUM-THORIUM DEPOSIT, ALASKA. E. M. MacKevett, Jr. *Mining Eng.* **11**, 915-19 (1959) Sept.

The Ross-Adams deposit (southern Prince of Wales Island, SE. Alaska) represents an uncommon type of U-Th deposit in which uranorthite and uranoan thorianite are the chief ore minerals. The deposit, which forms a crudely fusiform ore body in alkali granite, is the source of the only U ore that was mined in Alaska. (*GeoScience Abstr.* **2**, No. 3, 1960)

19212

NUCLEAR DETECTOR FOR BERYLLIUM MINERALS. T. Cantwell, H. E. Hawkes, and N. C. Rasmussen. *Mining Eng.* **11**, 938-40 (1959) Sept.

A semiquantitative method, depending on a nuclear reaction that is selective for Be, was developed experimentally. The method of determining the Be content of crushed mineral samples was given a preliminary test with standard laboratory equipment. (*GeoScience Abstr.* **2**, No. 3, 1960)

19213

METHODS FOR DETERMINING SMALL AMOUNTS OF NIOBIUM AND TANTALUM IN ORES. V. S. Bykova and V. I. Skrizhinskaya (All-Union Geological Inst., USSR). *Zavodskaya Lab.* **26**, 523-9 (1960). (In Russian)

Several current colorimetric methods for determining Nb and Ta were evaluated by comparing the results obtained from analyzing artificial mixtures and minerals, such as loparite, tantalite-columbite, perovskite, pyrochlore, cassiterite-tantalite and Ti-bearing minerals such as sphene. A modification of the thiosulfate method had a sensitivity of 0.05% Nb and was found useful when the sample contained less than 1% Ti. The dimethyl fluorene method for Ta was sensitive to 0.002% and could be used only if most of the Ti was previously removed from the

sample. The pyrogallol extraction method, based on the extraction of complex Ta fluoride with cyclohexane, presented a sensitivity of 0.01% of Ta, similar to the pyrogallol-tannin method used for both elements. If their concentration is smaller, the samples must be analyzed subsequently according to the first two methods. The absorption method allows a determination of the two elements without separating them, if their concentration is higher than 0.5%, although the individual sensitivity of the method is 0.05% for Ta and 0.005% for Nb. (TTT)

19214

URANIUM DEPOSITS IN THE DATIL MOUNTAINS-BEAR MOUNTAINS REGION, NEW MEXICO. p.135-43 of "New Mexico Geological Society. Tenth Field Conference, 1959. Guidebook."

Small deposits of U occur in Cretaceous and Tertiary rocks along a 40-mile belt on the N. side of the Datil, Galinas, and Bear mountains. Known deposits are in the Baca formation (Eocene?) and the Point Lookout(?) sandstone of the Upper Cretaceous Mesaverde group, sandstone, or shale intercalated with sandstone and usually associated with carbonaceous material and accompanied by V. Disseminated U minerals occur in the Baca formation of the Jaralosa Canyon area. In the upper Alamosa Creek area U mineralization occurs in: 1) a basal ferruginous channel-fill sandstone of the Baca formation on the Red Basin claims; 2) a carbonaceous ferruginous sandstone near McPhaul Ranch at the contact of the Point Lookout(?) sandstone with underlying shale of the Crevasse Canyon formation; and 3) a cross-bedded sandstone of the upper part of the Point Lookout(?) sandstone within a zone of carbonaceous shale laminae, a mile N. of the McPhaul Ranch. Chemical analyses from these prospects show a range of 0.001 to 2.31% U. There appears to be a relationship of the U deposits to ground-water movements as influenced by structure and stratigraphy. Structural troughs, porosity and permeability changes, and the presence of carbonaceous material all seem to have been important factors in the concentration of U. A clue to the ultimate source of the U may be the traces of U in volcanic rocks of the Datil formation of Miocene(?) age; descending meteoric waters may have leached radioactive material from the Datil formation tuffaceous rocks and deposited it in underlying rocks. The presence of eruptive centers of the Datil formation only a few miles from some of the deposits may point to a possible hydrothermal origin. (*GeoScience Abstr.* **2**, No. 5, 1960)

19215

Geological Survey, Washington, D. C.
OIL YIELD AND URANIUM CONTENT OF BLACK SHALES. Vernon E. Swanson. Geological Survey Professional Paper 356-A. 1960. 47p. \$0.30(GPO)

Some black shales containing oil and uranium are called uraniferous oil shales. Such shales have been considered as a potential source for both oil and uranium. Determinations are reported on samples of this type shale for oil yield and uranium content. The yield and content percentages are given for the types of shales and their localities. The oil yield is as much as 50 gallons per ton of shale and uranium content of 0.023%. (B.O.G.)

19216

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome. STUDI E RICERCHE DELLA DIVISIONE GEOMINERARIA. VOLUME II. (Study and Research of Geomineraria Division). 1959. 312p.

Fifteen reports dealing mostly with the geology and mineralogy of U deposits in Italy are presented. (T.R.H.)

19217

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

URANIFEROUS CONCENTRATIONS FOUND WITH THE ATESEINE IGIMBRITIC DEPOSITS. Mario Mittempergher. p.1-19 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The uranium deposits occurring within the ignimbrites of the paleozoic volcanic series in the Trentino-region have shown mineralogical and structural features which can be considered epigenetic to the country rocks. Starting from the chemical and mineralogical study of these radioactive deposits, the behavior of the uranium during the emplacement and cooling of the welded tuffs is discussed and some of the complex physical chemical equilibria due essentially to the gaseous phase of the eruptive magma are pointed out. The pneumatophile character of uranium and the considerable degassing processes accompanying and following the eruptions of glowing clouds are probably responsible for the present low contents of uranium in the rhyolitic ignimbrites and for the genesis of the local radioactive concentrations connected with these rocks. On the basis of general geological considerations and of the features of some uranium deposits connected with the late paleozoic sandstones of the western Trentino, an hypothesis is finally suggested on the genetic linkage between the Val Rendena ore deposits and the uranium mobilizing processes which occurred during the formation of the ignimbrites. (auth)

19218

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

ACTUAL STATE OF KNOWLEDGE ON URANIFEROUS MINEROGENESIS IN THE ITALIAN ALPS. Giorgio Marinelli and Mario Mittempergher. p.37-44 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The several uranium mineralizations to date found on the Italian side of the Alps occur almost always in rocks deposited after the post-hercynian emersion and before the permian-triassic marine ingression. These mineralizations can be arranged in three groups, according to their different ways of genesis, and to the characteristics of the host rocks: uranium concentrations in permian-triassic schists of the Penninic zone; in late paleozoic continental sandstones; and in late paleozoic volcanics. Except for the mineralizations in the hercynian granite of the Monte Bianco, no other uranium concentrations have ever been found but in late paleozoic rock. Explanations for such a distribution of uranium in the Alps are given. (auth)

19219

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

URANIFEROUS MINERALIZATION FOUND IN THE LATE PALEOZOIC PENNIDICS OF TAURI (ALTOADIGE). Aldo Brondi and Claudio Tedesco. p.45-74 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The most interesting uranium mineralizations in the pennidic zone of the Tauri (N-E Alto Adige) occur on the western slope of the "Picco dei Tre Signori." The mineralized beds and lenses occur in a horizon of quartz-muscovite schists, a facies of the originally sedimentary pretriassic series metamorphosed during the alpine revolution. In the mineralized zone this series is mostly formed by originally clastic, continental sediments deposited after the post-hercynian emersion and before the permian-triassic transgression. The uraniferous mineral in pitchblende; lack of any significant paragenetic mineral

association is the main characteristic. These deposits are very similar to the numerous uranium concentrations occurring in the pennidic pre-triassic metasediments in the Western Alps, and, as well as these, they are probably genetically related to the events of the permian-triassic transgression. (auth)

19220

[Italy. Comitato Nazionale per le Ricerche Nucleari, Divisione Geomineraria, Rome.]

DISTRIBUTION OF ELEMENTS ASSOCIATED WITH URANIUM IN DEPOSITS OF THE ITALIAN ALPS. G. Falchi, D. Neri, and G. Serrini. p.75-96 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Significant information on the genesis of sedimentary mineralizations can be provided by a statistical study of the distribution of some elements most commonly associated with uranium in this kind of deposit. The P, As, V, Cu, Pb, Zn, and Mo contents of several specimens from the uranium sedimentary mineralizations of the Italian Alps are reported representing a first contribution for such statistical research. The amount of data is not large enough to allow the definition of valid paragenetic rules; in the conclusions it is possible nevertheless to make a few considerations that permit a better characterization of the genesis of the three types of deposits examined, in the light of the general geochemical informations. The differences in the distributions of V, As, Pb, P, and Cu seem to be of considerable interest. The validity of these methods of research is expected to be confirmed in future works. (auth)

19221

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

DETERMINATION BY C¹⁴ OF THE AGE OF A FOSSIL TREE OF CAMPI FLEGREI (NAPLES). P. Lucini and E. Tongiorgi. p.97-9 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

A fossil tree is described, found during the perforation of the tunnel through the Vomero hill for the Circum-phlegrean railway, in a greenish-gray tuff belonging to the yellow tuff formation of Naples. The age of this fossil wood has been determined by the C¹⁴ method in the Laboratory of Isotopic Geology of the Divisione Geomineraria of the C.N.R.N. at Pisa and has been found to be of 10,090 ± 215 years. (auth)

19222

Italy. Comitato Nazionale per le Ricerche Nucleari.

Laboratorio di Geologia Nucleare, Pisa; Italy. Comitato Nazionale per le Ricerche Nucleari, Rome; and Naples. Università. Istituto di Geologia Applicata.

DETERMINATION BY THE LEAD METHOD OF THE AGE OF A PEGMATITE VEIN NEAR DELIANUOVA (ASPROMONTE, CALABRIA). G. Ferrara, F. Ippolito, H. Stauffer, and E. Tongiorgi. p.101-8 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The scarcity of geologic data about Calabria has since now enabled us to consider the granitic intrusions of Aspromonte of pre-jurassic age only. A sample of almost pure uraninite found in a pegmatitic vein near Delianuova (Aspromonte) has allowed the determination, with the lead methods, of the following absolute ages: U²³⁸/Pb²⁰⁶ (190 ± 10) × 1000 yr; U²³⁵/Pb²⁰⁷ (190 ± 10) × 1000 yr; Pb²⁰⁶/Pb²⁰⁷ (200 ± 30) × 1000 yr. (auth)

19223

Italy. Comitato Nazionale per le Ricerche Nucleari.

Laboratorio di Geologia Nucleare, Pisa and Bern. Universität. Physikalisches Institut.

ISOTOPIC ANALYSIS OF LEAD IN URANIFEROUS SEDI-

MENTS OF EASTERN ALPS. G. Ferrara, H. Stauffer, and E. Tongiorgi. p.109-27 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Some samples from the Val Rendena belonging to the formation of Arenarie di Val Gardena were studied. Only two samples of silicized wood gave a correct absolute age of 220,000 yr by the lead methods. All other samples presented the effect of uranium and lead mobilization, caused by the alpine orogenesis; the results obtained were compared with others, some of them unpublished, concerning the western Alps. (auth)

19224

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

LEACHING TESTS OF URANIUM OF CANALE MONTERANO. G. Alberti, C. Bettinali, G. Grassini, and F. Silvestro. p.129-53 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Short descriptions of the deposit, of the various hypotheses of its origin and of the methods of sampling are given. The results of the radiometric and chemical analyses of samples collected in the various galleries are reported. The conditions of solubilization of the uranium in pure water and in acidic and alkaline solutions were studied, taking in account the concentration of the solutions, the time of leaching, the temperature, the grain size of the crushed material, the presence of oxidizing compounds and of oxygen under pressure. It was found that in the case of leaching by water only, the percentage of uranium going in solution is strictly linked to the acidity of the material. Most of the examined samples shows pH-values between 2.4 and 3.2, but also extreme values, such as 1.8 and 5.5 were observed. On the average, about 18% of the total uranium present goes in solution in pure water, while, in solutions with 20% sulfuric acid, maximally 60% of the uranium could be leached out. (auth)

19225

[Italy. Comitato Nazionale per le Ricerche Nucleari, Divisione Geomineraria, Rome.]

A RAPID METHOD FOR DETERMINATION OF Po^{210} IN RADIOACTIVE MINERALS. L. Ancarani and L. Riva. p.155-9 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

A method, based on the spontaneous deposition of Po^{210} , is described which permits the quantitative determination of the uranium in radioactive minerals. This method may be applied to minerals that contain only 1 gr/ton of uranium with an error of less than 5%. (auth)

19226

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

AN INTRODUCTORY EXAMPLE OF THE USE OF GEO-CHEMICAL CRITERIA IN THE STUDY OF URANIFEROUS MINERALIZATION IN THE ALPS. M. Dall'glio, G. Marinelli, and F. Tonani. p.162-201 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The structural and weathering conditions of an alpine uranium-bearing ore-deposit (Val Rendena), and the aureoles of hydrogeochemical, "clastic" and pedogeochemical dispersion resulting by them are described. On the basis of general geochemical considerations, and of the particular behavior of uranium, the use of geochemical methods in prospecting uranium-bearing deposits is discussed. (auth)

19227

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

RESEARCH ON SOURCES OF ERROR IN THE DETERMI-

NATION OF URANIUM AND THORIUM BY ALPHA PULSE SPECTROMETRY. Carlo L. Garavelli. p.203-35 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

The practical application of the alpha spectrometry to the solution of mineralogical and geochemical problems under routine conditions is studied. For the preparation of the alpha-emitting thin layers, a technique was developed, which is based upon the grinding of the sample in methanolic suspension, and the subsequent deposition of the layer from the same liquid. Such a very simple and quick technique gives excellent spectral resolution. From the results of several series of determinations carried out on standards with known contents in U and Th, the absence of systematic errors in the absolute estimations of these elements is shown; the coefficient of variation ranges from 3 to 7 per cent. Starting points for such determinations may be either the measurements of the areas under the peaks in the counts per channel vs. energy plots, or the total number of counts read on the scaler within the spectral range corresponding to each peak. The two methods are perfectly equivalent both in precision and accuracy. For the estimation of the U/Th ratios, precisions were obtained which agree with the dispersions in the measurements of the absolute contents in U and Th. The evaluation of such ratios by means of the heights of the peaks leads to exceedingly poor accuracies and precisions. The contribution of each actual source of error to the total variance is also emphasized. (auth)

19228

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

RECENT RESEARCH ON SECONDARY URANIUM MINERALS OF VAL RENDENA. Carlo L. Garavelli and Fiorenzo Mazzi. p.237-58 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Some U-bearing secondary minerals occurring in the lower zones of the U-deposit of Val Rendena in the southwest of Trentino were studied. Particular methods were employed in order to identify the very small quantities of available materials. Normally, the identification was accomplished by means of x-ray methods, both diffractometric and spectrographic. The following minerals were found: becquerelite, wölsendorfite, epi-ianthinite (or ianthinite), curite and the "mineral A of Frondel" among the hydroxides; kasolite (very widespread) and uranophane among the silicates; renardite, ferroan metazeunerite and metatuyamunite among the phosphates, arsenates and vanadates. The paragenetic significance as well as some chemical features of these minerals are emphasized. (auth)

19229

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

NEWLY DISCOVERED URANIUM MINERALS IN ITALY. Carlo L. Garavelli and Francesco Rinaldi. p.259-74 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Some specimens of minerals of the torbernite and metatorbernite group from Preit (Cozian Alps) and Camigliatello Silano (Calabria) were studied. The specimens from Preit deposits are formed by a member of the torbernite-zeunerite series, rarely associated with a member of the autunite-uranospinite series. The corresponding dehydration products have also been found. The lattice parameters of the various minerals were calculated, and the geochemical significance of the presence of arseniates among the secondary minerals of many alpine uranium deposits is discussed. Autunite was found at

Camigliatello Silano. It has a considerably disordered reticular lattice, due very likely to the degree of dehydration of the mineral. (auth)

19230

[Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.]

DATA AND OBSERVATIONS ON THE CRYSTALLOGRAPHY OF PARSONITE. F. Mazzi, C. L. Garavelli, and F. Rinaldi. p.299-309 of "Studi e Ricerche Della Divisione Geomineraria. Volume II." 1959.

Parsonite, $\text{Pb}_2\text{UO}_2(\text{PO}_4)_2 \cdot n\text{H}_2\text{O}$ ($n = 0 + 2$), has been studied both optically and by x rays, in order to obtain new, more complete data. It is triclinic, with the following lattice constants: $a_0 = 6.862$; $b_0 = 10.425$; $c_0 = 6.684 \text{ \AA}$; $\alpha = 101^\circ 26'$; $\beta = 98^\circ 15'$; $\gamma = 86^\circ 17'$. Two formula units are contained in the unit cell; the calculated specific gravity is $6.21 + 6.47$, depending on the number of H_2O molecules in the formula. Rough positions of the heavy atoms in the unit cell are given, it is however very difficult to distinguish between the lead and uranium positions and to determine those of the lighter atoms. Parsonite crystals can be flattened either on (100) or (010). The extinction angle $c \wedge Y'$ is about 12° and the elongation is positive in the former case, whereas in the latter the extinction angle $c \wedge Y''$ is about 19° with negative elongation. Some apparent discordances in the literature data can be explained with the suggestion that the optical observations, referred in the literature to the flattening plane taken always as (010), have been some times accomplished on crystals flattened (100). (auth)

HEALTH AND SAFETY

19231 AD-230086

Naval Civil Engineering Research and Evaluation Lab., Port Hueneme, Calif.

NUCLEAR RADIATION SHIELDING PROVIDED BY BURIED SHELTERS. Technical Report 025. Type C. Interim Report. J. C. LeDoux. Oct. 27, 1959. 77p.

Methods of calculating the attenuation of initial gamma, initial neutron, and residual gamma radiation incident upon buried shelters from fission-type weapons are discussed. Attenuation curves are presented which take into account variations in the moisture content and density of the soil cover. The effects of the various energy spectra for each type of radiation were considered. Shelter configurations which were investigated include the rectangular or slab, the hemisphere, and the arch. Although a simplified model was assumed, comparison with experimental values of attenuation factors for flexible arch-type structures indicates that the methods developed in this report will predict doses or attenuations within a factor of two. (auth)

19232 AERE-M-620

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE RADIOACTIVITY OF THE ATMOSPHERE NEAR GROUND LEVEL DUE TO DISTANT NUCLEAR TEST EXPLOSIONS. D. K. Peirson, R. N. Crooks, and E. M. R. Fisher. May 1960. 8p. BIS.

Samples of airborne dust were collected at Chilton, Berkshire. Tables and graphs show the total beta activity and the Cs^{137} content of these samples from 1953 to March 1960 and the Zr^{95} content from August 1957 to March 1960. The Cs^{137} content shows a seasonal variation similar to that found previously in Sr^{90} in rain. The monthly concentration of Cs^{137} activity rose to a peak value of $10^{-13} \mu\text{c/cc}$

in May, 1959. The corresponding values derived for Sr^{90} and Pu^{239} were 7×10^{-14} and $10^{-16} \mu\text{c/cc}$, respectively. (auth)

19233 ARF-3127-6

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Summary Report. John Rosinski and John Stockham. Apr. 30, 1959. 51p. ARF Project C 127. Contract AT(11-1)-626. OTS.

Preliminary studies were made of the relationship between the size of particles suspended in the lower atmosphere and the amount and nature of radionuclides they contain. Emphasis was placed on the distribution of strontium-90. From a limited number of analyses, it was found that strontium-90 is associated primarily with particles below 0.1 micron in diameter. Preliminary studies were made of scavenging of particles by liquid water droplets. Studies are included of sticking probability and the effects of Brownian motion and water vapor diffusion. It was found that electrostatic effects are of primary importance for 1.9-micron (mean volume diameter) particles. Brownian motion and water vapor diffusion did not contribute to the scavenging. These results are based on known and new equations derived for various scavenging conditions. (auth)

19234 ARF-3127-7

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Letter Report No. 7 Covering Period April 1 to May 31, 1959. John D. Stockham and John Rosinski. June 15, 1959. 6p. ARF Project C 127. Contract AT(11-1)-626.

Progress is reported on the development of a cyclone which will remove particles larger than 8 microns. A method is proposed for a more efficient separation of particles by increasing the number of size separation filters in the sampling train. Preliminary tests with sub-micron polystyrene particles are being conducted. Numerous methods have been tried for counting the particles in a water droplet of the polystyrene aerosol. The criteria for a satisfactory method of counting particles are discussed. A proposed method to accomplish this is to use carbon-14 labeled polystyrene hydrosols. (For preceding period see ARF-3127-6.) (B.O.G.)

19235 ARF-3127-8

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Letter Report No. 8 Covering Period June 1 to August 1, 1959. John Stockham and John Rosinski. Aug. 20, 1959. 7p. ARF Project C 127. Contract AT(11-1)-626. OTS.

Progress is reported on the separation of airborne particles into size fractions for radioactive analysis. Laboratory studies of scavenging systems were conducted using a latex suspension diluted 1 to 500 parts with polystyrene then atomized with a Lauterbach generator. Tests were conducted for the collection of polystyrene particles by an evaporating water droplet. The results from these tests are included. The size distributions of particles obtained from atomizing latex and 1% gelatin suspensions are tabulated. The latex suspensions were diluted 1:500, 1:100, and 1:10. Future laboratory studies are to be directed toward elimination of charged aerosol particles and the use of radiochemical techniques for determining the amount of material collected by a water droplet. (For preceding period see ARF-3127-7.) (B.O.G.)

19236 CF-60-3-49

Oak Ridge National Lab., Tenn.

CONTAMINATION OF SHIPPING CASK AND STORAGE CANAL WATER BY FUELS IRRADIATED IN PRESSURIZED WATER REACTORS—A REVIEW OF PERTINENT SUBJECTS. L. J. King. Mar. 17, 1960. 21p. OTS.

The subjects of fuel element failures, rates of release and redeposition of radioactive materials from ruptured and intact fuel elements in pressurized water reactors, corrosion rates of fuels in canal water and in contact with pressurized water, activity in storage canal water, fuel meltdown studies, and decontamination are reviewed and evaluated in relation to the shipment and storage of irradiated fuel elements. Radioactive crud deposited on fuel element surfaces is a potential source of excessive fuel element carrier and storage canal contamination and must be evaluated in relation to irradiated fuel element shipment and storage. Fuel elements which have small cladding penetrations are not likely to cause significant contamination of carrier and storage canal water. (auth)

19237 CF-60-7-28

Oak Ridge National Lab., Tenn.

PLUTONIUM HANDLING—A LECTURE PRESENTED TO THE REACTOR SCHOOL BY C. J. BARTON, JULY 12, 1960. C. J. Barton. July 13, 1960. 12p. OTS.

A discussion of the hazards and philosophy of plutonium handling is presented. Glove box construction and materials are also discussed along with handling techniques and work being done with plutonium in various parts of this country. (J.R.D.)

19238 FFF-IR-F-399

Norway. Forsvarets Forskningsinstitutt, Lillestrøm.

ON THE TRANSPORTATION AND DEPOSITION OF FALL-OUT MATERIALS. S. H. Small. Apr. 20, 1960. 20p.

Some aspects of the behavior of airborne materials are discussed in relation to the deposition of nuclear explosion residues. It is suggested from measurements made mainly in Norway, that fall-out materials tend to settle fairly rapidly through predominantly horizontal winds in upper air layers. Particle settling rates increase considerably in the convective friction layer nearer the earth. (auth)

19239 FZM-1968

Convair, Fort Worth, Tex.

PREDICTING THE ATMOSPHERIC DIFFUSION OF FISSION PRODUCTS. J. C. Couchman. June 12, 1960. 19p.

Paper presented at the Summer Meeting of the American Nuclear Society, Chicago, June 12-15, 1960.

Methods are described for predicting the downwind concentrations of radioactivity released from a reactor accident. A statistical type of atmospheric diffusion equation is presented and its different diffusion coefficients are defined. A mathematical method is presented by which empirical atmospheric diffusion coefficients may be obtained from experimental data. A statistical representation is given of the values of atmospheric diffusion parameters obtained by applying the mathematical method. Predictions based on the mathematical averages of fitted diffusion parameters are compared with results from field tests of fission product release. A method is recommended for predicting atmospheric diffusion. The accuracy of the method is discussed. (C.H.)

19240 FZM-1970

Convair, Fort Worth, Tex.

ATMOSPHERIC FISSION PRODUCT FIELD RELEASE TESTS. J. E. Werle. June 12, 1960. 24p.

Paper presented at the Summer Meeting of the American Nuclear Society, Chicago, 12-15 June 1960.

A study was made of the potential hazards associated with the release of fission products from a nuclear reactor. In considering the hazards associated with a fission-product release, it is assumed that a nuclear accident always involves the release, in vapor form, of the entire radioactive inventory of the reactor. Results are reported from a study of diffusion patterns following a total of twenty fission product releases in which irradiated fuel elements were melted and the resulting radioactive effluent released to the atmosphere. Both aged and freshly-irradiated fuel elements were used. The pre- and post-melt gamma dose rates were measured to provide information on gross gamma release percentages and the percentages of cesium-137 released were determined. The measured amount of cesium was used to determine the strontium-90 release percentages. Air-samplers were assayed to evaluate the release percentages of ruthenium-103, cerium-141, zirconium-95, niobium-95, and cesium-137. The atmospheric dilution factor was evaluated from the iodine-131 assay. Data are tabulated and presented graphically. (C.H.)

19241 HW-48980

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

NOISE REDUCTION PROGRAM, 300 AREA (PROJECT CG-640). T. W. Gore. Mar. 12, 1957. Decl. May 4, 1960. 33p. Contract W-31-109-Eng-52. OTS.

Early in 1955 the Manufacturing Department in cooperation with the Industrial Medical Section, embarked on a program of noise abatement. The whole problem of noise control was thoroughly studied, and a program was developed for reducing the noise levels where necessary. The program was primarily directed toward the classification and interpretation of noise sources which affect health, safety and morale of personnel. It became evident from the studies that the 300 Area had different controlling factors than the other areas, and that corrective action should not be delayed pending developments at other areas. As a result, steps were taken to obtain the quantitative information necessary to correct or improve on the problem within the confines of the 300 Area Manufacturing Operation, now as a part of Fuels Preparation Department. (auth)

19242 HW-64371

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1959. R. L. Junkins, E. C. Watson, I. C. Nelson, and R. C. Henle. May 9, 1960. 123p. Contract AT(45-1)-1350. OTS.

The environmental radiation exposure to personnel in the vicinity of the Hanford area is estimated for each of the critical organs of major interest, i.e., the gastrointestinal tract, bone, and total body for doses received during 1959. Multiple sources and path of intake are considered. The estimated dose (10 to 15% of that permitted by the recommendations of the NCRP) consists primarily of the dose due to ingestion of drinking water and foodstuffs which have been irrigated by river water containing diluted reactor cooling water. (C.J.G.)

19243 KY-332

Union Carbide Nuclear Co. Paducah Plant, Ky.

ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1959. E. G. Brown and K. K. Mitchell. May 31, 1960. 9p. Contract W-7405-eng-26. OTS.

Outdoor monitoring of air, water, and vegetation in the vicinity of the Paducah Plant is summarized for the year 1959. (auth)

9244 NP-8793

Corps of Engineers.

DESIGN OF STRUCTURES TO RESIST THE EFFECTS OF ATOMIC WEAPONS. BURIED AND SEMIBURIED STRUCTURES. Jan. 15, 1960. 72p. (EM-1110-345-421).

The design of shelters for military installations is considered. Design criteria are presented for the construction of buried and semiburied structures. A comparison of the relative advantages of the two types of structures indicates that the dynamic loading is more severe in some cases for semiburied than for buried structures. However, semiburied structures require less excavation, are easier to provide with accessways, and are simpler to drain. Differences in design procedure for rectangular and shell types of construction are considered. Under uniform loading the curved elements in the shell type of construction are very rigid and are designed by static design methods, whereas the linear elements of rectangular structures are relatively flexible and are proportioned using dynamic design methods. The criteria considered include design for effects of air burst, effects of ground motion, drainage problems, and the design of doors to resist pressure rebound and suction forces caused by the air blast, and ventilation systems. Procedures are included for calculating air- and surface-burst load curves. These are applied in the design of roof slabs, roof girders, interior columns, column footings, and walls. (C.H.)

19245 NP-8853

Naval Civil Engineering Lab., Port Hueneme, Calif.

RADIATION SLIDE RULE FOR ATOMIC FALLOUT PROBLEMS. Technical Report 083. Y-F011-05-401. Type C, Final Report. J. C. LeDoux. May 24, 1960. 31p.

The theory, construction, and use of a circular slide rule are presented. It is designed to solve passive-defense residual-radiation problems. The rule is based on the $t^{-1.2}$ law of radioactive decay and can solve an infinite number of problems without recourse to tables, construction, or graphic plots. Several typical problems are worked with the slide rule to demonstrate it. (auth)

19246 R59TMP-66

General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.

THE NATURE AND EFFECTS OF WORLDWIDE FALLOUT FROM NUCLEAR WEAPONS. G. M. Wiederholt. Nov. 20, 1959. 84p.

Results are presented from a brief and general survey of the progress made during the past decade in determining the nature and effects of radioactive fall-out from nuclear weapons. Since many weapon reports consider the immediate or short term fall-out from nuclear weapons, this survey was confined to worldwide or long-term fall-out which becomes a possible source of internal radiation damage. Although there are a number of radioisotopes to be considered, worldwide fall-out is represented here by strontium-90 and carbon-14. Preceding the discussion of these radioisotopes consideration is given to the nature of ionizing radiation, units of radiation measurement, the biological effects of radiation, characteristics of fall-out, and internal radiation from fall-out. (auth)

19247 RISÖ-14

Denmark. Atomenergi-kommissionen. Forsøgsinstitut, Risø.

ENVIRONMENTAL RADIOACTIVITY AT RISÖ 1959.

A. Aarkrog and J. Lippert. June 1960. 48p.

Results of measurements are tabulated on the background radioactivity in the Risö Area during 1959. Like previous years, the measurements include determination of

β -activity in a number of samples. Regular surveys were carried out on sea water, soil, air, bed-soil, eel, fresh water, precipitation, grass, sea plants, and milk. Strontium-, cerium, cesium- and ruthenium-activity was determined in air, precipitation, and vegetation. Samples of milk and corn for strontium-90 determination were obtained from different parts of the country. (C.H.)

19248 RM-2460(RAND)

RAND Corp., Santa Monica, Calif.

DERIVATION OF TWO SIMPLE METHODS FOR THE COMPUTING OF RADIOACTIVE FALLOUT. E. S. Batten, D. L. Iglehart, and R. R. Rapp. Feb. 18, 1960. 52p. Contract AF49(368)-700.

The mathematical derivation is presented of two methods for computing the radioactive fall-out at a point. Information is given which will permit the final calculation of dose or dose rate. (auth)

19249 SC-4414(RR)

Sandia Corp., Albuquerque, N. Mex.

COMPARISON OF FALLOUT DOSES FROM NEVADA TESTS (REVISED). Jack W. Reed. June 1960. 42p. OTS.

Many residents of the Nevada area carried film badge radiation dosimeters during Operation Plumbbob in 1957. Badge readings in specific localities appear to follow the logarithmic-normal distribution. Badges appear to record an average of 22% of infinity fall-out dose for the area. One-sixth of the badges record less than 8.5% and one-sixth more than 55% of the infinity dose. These statistics are applied to infer maximum doses to people in the region and to show maximum fall-out which can be allowed on populated localities without exceeding specified maximum doses to any inhabitant. (auth)

19250 TID-6117

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Letter Report No. 4 Covering Period October 1 to December 1, 1958. John D. Stockham and John Rosinski. Dec. 22, 1958. 3p. Contract AT(11-1)-626. OTS.

Research was continued in the separation of airborne particles from radioactive fall-out. An Anderson sampler was used to collect the particles from a volume in excess of 100,000 cu ft, required for strontium-90 analysis. Equipment to study the effect of Brownian and vapor diffusion on the capture of submicron particles by water droplets was set up. The performance of the equipment was tested using polystyrene latexes and gold sols. The results of the tests showed that the aerosol-generating and diluting stages work satisfactorily, and the humidifier requires modification to eliminate supersaturation and droplet entrainment. (For preceding period see AECU-3880.) (B.O.G.)

19251 TID-6118

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Letter Report No. 5 Covering Period December 1, 1958 to January 31, 1959. John D. Stockham and John Rosinski. Feb. 20, 1959. 6p. ARF Project C 127. Contract AT(11-1)-626. OTS.

Research is reported in the classification of particles scavenged from air by a millipore filter and a cyclone separator. Several materials were tested in an effort to obtain a satisfactory aerosol for the study of the capture mechanism by a water droplet. These materials included

polystyrene, sodium chloride, and fluorescent zinc sulfide. Future work includes a continuation of air sampling and finding a suitable aerosol to study the droplet capture mechanism. (For preceding period see TID-6117.) (B.O.G.)

19252 TID-6123

New York Univ., New York. Graduate School of Arts and Sciences.

THE MEASUREMENT OF ENVIRONMENTAL RADIATION. Annual Report and Proposed Program for the Period September 1, 1960 to August 31, 1961. July 1, 1960. 35p. OTS.

Progress is reported in the development of instruments for use in measurements of environmental radiation. Results are reported on performance tests of a standard ion chamber employing Freon-12 gas. Other mixtures of electro-negative gases were tested as possible substitutes for Freon-12. A system consisting of a 73.6 liter ionization chamber, a vibrating reed electrometer, and a strip-chart recorder was tested as a monitoring system. The design and performance are described for a parallel plate chamber used in conjunction with a collimator. Results are reported from studies using the equipment to measure alpha ionization in air and Freon-12 at atmospheric pressure. (C.H.)

19253

MEASUREMENT OF ABSORBED DOSES RECEIVED FROM EMANATION AND DECAY PRODUCTS THEREOF. L. S. Ruzer. *Atomnaya Energ.* 8, 542-8(1960) June. (In Russian)

A method is suggested for measuring the doses from absorbed radon, short-life β emitters RaB and RaC, and long-life radon daughters. Measurements were also made for thoron and actinon and new maximum permissible concentrations of thoron and radon in air are quoted. The suggested method of dose determination can be applied for any radioactive chain absorbed by organism. The feasibility of individual dosimetric control emanation daughter products in the respiratory passages is confirmed. (tr-auth)

19254

A PROCEDURE FOR THE DIRECT AND CONTINUOUS DETERMINATION OF RADON IN THE AIR. Daniel Blanc, Jacques Fontan, and Gilbert Vedrenne (Faculté des Sciences, Toulouse, France). *Compt. rend.* 250, 3629-31 (1960) May 30. (In French)

A method is given for the continuous measurement of the radon concentration in the air. Atmospheric air, after having passed through a paper filter, passes into an air-tight decay chamber (200 to 1000 l). At the outlet the particles of the descendants are collected on a filter. The α activity of the filter is then measured. The apparatus permits the determination of radon concentrations of 2×10^{-14} c/l. (tr-auth)

19255

THE LOCATION OF LOST γ -RAY OR NEUTRON SOURCES. M. L. Randolph (Oak Ridge National Lab., Tenn.). *Health Phys.* 2, 408-9(1960) May.

A method is described for the systematic and precise location of lost sources emitting penetrating radiations, gamma rays or neutrons. (C.H.)

19256

REPORT OF THE ICRP COMMITTEE II ON PERMISSIBLE DOSE FOR INTERNAL RADIATION (1959), WITH BIBLIOGRAPHY FOR BIOLOGICAL, MATHEMATICAL AND PHYSICAL DATA. *Health Phys.* 3, 1-380(1960) June.

Values are recommended for the maximum permissible

body burden of radionuclides and maximum permissible concentration of these nuclides in air, water, or food. Data are tabulated for the more important radionuclides encountered in occupational exposure. The values are based on the best available information. A complete bibliography and an index of elements are included. (C.H.)

19257

SAFER PACKAGES FOR SHIPPING FUEL. W. B. Lewis and R. W. Goin (Phillips Petroleum Co., Idaho Falls, Idaho). *Nucleonics* 18, No. 7, 91; 93(1960) July.

Shipping and storage of fissionable material can be made safe by separating packages with a poison-moderator-poison sandwich composed of cadmium foil and solid hydrogenous material (wood or polyethylene). Such sandwiches can be used to wrap flat or cylindrical samples and to contain fuel bottles and fuel elements (laminated polyethylene); illustrative drawings are given. Safety factors for thickness, etc., computed for "criticalium" with a 750-barn fission cross section, are given. (D.L.C.)

19258

BERYLLIUM CONCENTRATION IN THE AIR OF A BERYLLIUM ALLOY HANDLING FACTORY. Noboru Hara, Akira Hamada, Kosuke Nozaki, and Hiroyuki Sakabe. *Rodoisei Kenkyûsho Kenkyû Hôkoku* No. 1, 54-9(1958). (In Japanese)

Electrostatic precipitators are used to measure the concentration of beryllium dust in the air during various phases of cutting and melting operations; filter-paper type dust collectors are used to measure the concentration at different times of the day. Collected dust particles are analyzed by measuring the fluorescence of beryllium due to irradiation by ultraviolet rays. The spectrum of such fluorescence is taken, but the total spectrum of such fluorescence is used for intensity measurement. Interference resulting from impurity ions in the samples during the measurement of fluorescence is reduced by chemical separation and addition of appropriate reagents. The result indicates that the maximum concentration $1.83\gamma/\text{m}^3$ is obtained during cleaning of the furnace, and the minimum concentration $0.11\gamma/\text{m}^3$ during the melting operation. (JPRS)

19259

URANIUM CONCENTRATION IN THE AIR OF A URANIUM PROCESSING PLANT. Noboru Hara, Shigezi Koshi, Kosuke Nozaki, and Hiroyuki Sakabe. *Rodoisei Kenkyûsho Kenkyû Hôkoku* No. 1, 60-4(1958). (In Japanese)

The concentration of uranium is determined in order to obtain basic data useful for preventing occupational diseases. A large electrostatic precipitator with a flow rate of 50 l/min is used to collect samples at various locations where different functions are performed, crushing, melting, and cutting. The concentration of uranium in collected dust particles is determined by measuring the fluorescence of uranium due to irradiation by ultraviolet rays from an ultra-high-pressure mercury vapor lamp. An interference filter is used to allow a peak fluorescence at 543 m μ to be detected by a photomultiplier 931A. The sensitivity of the system is 5/10,000 γ . Impurity interference is found to be negligible. The results indicate that the maximum concentration is found in the crushing chamber with $3.22\gamma/\text{m}^3$ and the minimum in the ore selection room with $0.15\gamma/\text{m}^3$. (JPRS)

19260

Gt. Brit. Ministry of Labour and National Service, London and Gt. Brit. Central Office of Information, London. RADIOACTIVE MARKERS IN GO-DEVILS: SAFETY PRECAUTIONS. Safety, Health and Welfare. New Series No. 7.

1959. 13p. 1s.0d.(Her Majesty's Stationery Office, London)

Safety precautions in the detection of stuck pipe line scrapers or go-devils with an installed Co⁶⁰ source are given: code of good practice and maximum permissible exposure levels. Instructions for detection are also given. (D.L.C.)

19261

Public Health Service, Washington, D. C.

RADIOLOGICAL HEALTH DATA. Monthly Report [for] June 1960. 1960. 35p. \$0.50(OTS).

Data are tabulated on radioactivity in samples of milk, air, and water collected throughout the U. S. during 1959. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

19262 AD-227361

Kaman Aircraft Corp., Bloomfield, Conn.

DEVELOPMENT AND FABRICATION OF NON-DESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT EMPLOYING RADIATION TECHNIQUE. Monthly Progress Report for July 1959. 10p. Contract DA-19-059-501-ORD-2631. (KAC-58-92-PR-14).

The work accomplished on the specific gravity-measuring instrument was (1) the construction of its shielding, (2) the performance of accuracy tests, and (3) designing the relay matrix for the measurement of the sample thickness. In (1), a light-weight metal cover was installed over the entire test table. In (2), it was found that separation of the main source beam, photomultiplier variations, and misadjustment of the source positions relative to the chopper were contributing to the large variation found in the detector stability. Means for remedying this variation are described. The matrix in (3) utilizes two banks of stepping relays to read the outer and inner dimensions of the sample. (D.L.C.)

19263 AD-227748

Nestlé Co., Inc., White Plains, N. Y.

RADIATION STERILIZATION OF COCOA POWDERS. Report No. 1 (Progress) [for] February 17, 1959-May 17, 1959. H. J. Fagen. 3p. Project No. 7-84-01-002. Contract QMR&E (NATICK) No. 114.

Results are reported from a study of the radiation dosage required to reduce the microflora of cocoas to a practical level without imparting off-flavor to the cocoas. Both dutched and natural cocoas of high and low fat content were studied. Results are tabulated from bacterial counts, peroxide values, and flavor evaluations on samples exposed to various levels of radiation. From a flavor standpoint, the maximum dosage appears to be 0.1×10^6 rads. The bacterial counts are sufficiently reduced at this dosage so as to be of practical interest. (C.H.)

19264 AD-227786

Southwest Research Inst., San Antonio.

DETECTION OF RADIATION INDUCED FREE RADICALS BY PARAMAGNETIC RESONANCE. Report No. 5 (Progress) [for] January 14, 1959-March 13, 1959. W. W. Bradshaw. 12p. Project No. 7-84-01-002. Contract DA-19-129-QM-1060.

Studies of food constituents including free radical acceptors were continued. The effect of water in irradiated albumin-water mixtures was investigated. Free radical production and decay were examined in samples of whole meat. (auth)

19265 AD-227792

Nuclear Science and Engineering Corp., Pittsburgh.

DEVELOPMENT OF AN ASSAY FOR PROTEOLYTIC ENZYME ACTIVITIES IN IRRADIATED MEATS AND APPLICATION OF THE ASSAY IN HEAT/RADIATION ENZYME INACTIVATION STUDIES. Report No. 2 (Progress) [for] Period: November 10, 1958-March 9, 1959. Abraham Edelmann. 10p. Project 7-84-01-002. Contract DA19-129-QM-1211.

Progress is reported in the development of assay methods for proteolytic enzyme activities in irradiated meats. (C.H.)

19266 AD-227811

DeBell and Richardson, Inc., Hazardville, Conn.

TO INVESTIGATE MATERIALS FOR CONTAINERS FOR PACKAGING FOODS. Report No. 13 (Progress) for Period November 28, 1958-January 28, 1959. Wesley S. Larson. 17p. Project 7-84-01-002. Contract DA-19-129-QM-764.

Progress is reported in the development of containers for use in the preservation of food by radiation. Data are included from tests on experimental polyethylene-aluminum six-ply pouches; the permeability of various films, foils, and combinations thereof; aluminum cans; and a polycarbonate sheet. (C.H.)

19267 AD-227911

Armour and Co. Food Research Dept., Chicago.

DEVELOPMENT OF IRRADIATED RATION TYPE MEAT ITEMS. Report No. 7 (Final) for October 29, 1957 to January 28, 1959. H. P. Furgal. 65p. Project No. 7-84-01-002. Contract DA-19-129-QM-1049.

Beef, pork, and chicken products were prepared in gravy and in barbecue sauce. Several processing variations, primarily on beef in saline, were also included. The irradiation levels which were used ranged from 1.5 to 5.0 Mrad. Products were evaluated immediately following irradiation and after 3 and/or 6 months storage at 70 to 75°F. Some of the products were found initially acceptable as to flavor, 3 Mrad was generally preferred over 5 Mrad irradiation. Some of them were stable or improved in flavor during storage. All of the stored samples were free of bacteriological spoilage. The use of barbecue sauce produced the best items. (auth)

19268 AD-227936

Quaker Oats Co. Research Labs., Barrington, Ill.

USE OF VARIOUS AMOUNTS OF RADIATION AND HEAT PROCESSING IN THE PRESERVATION OF CANNED FOODS. Report No. 11 (Progress) for January 1, 1959-March 31, 1959. E. F. Caldwell. 15p. Project No. 7-84-01-002. Contract QMR & E (Natick) No. 15 (Agreement).

Chili which was heat processed for 30 or 60 minutes at 245°F before irradiation was preferred by a taste panel over chili which was not cooked prior to irradiation. Data are included from a study of the effects of antioxidants and spices on color and flavor. (C.H.)

19269 AD-228151

McCormick and Co., Baltimore.

THE EFFECT OF IONIZING RADIATION ON SPICES. Report No. 8 (Final) [for] September 26, 1955-September 25, 1958. R. L. Hall. 13p. Project No. 7-84-01-002. Contract QM R & D (Natick) No. 28 (Agreement).

Insect infestation can be eliminated in spice products by ionizing radiations. In practically every case, the irradiated spices examined showed no evidence of live insects after three months incubation; this was at levels of 50,000 and 75,000 rep. When irradiated with 3×10^6 rep, no

significant change in the character of the spice itself occurred, as measured by triangle comparisons using a panel of about 20 members. None of the spices investigated, when combined in frankfurters and pork sausage and irradiated at 0.75 to 3.0×10^6 rep, showed any tendency to significantly mask or prevent ionized flavor and odor. In general, irradiation appears to reduce the odor and flavor of spices in pork sausage. (auth)

19270 AD-229149

American Can Co., Barrington, Ill.
RESEARCH STUDY ON CAN ENAMELS AS PART OF THE RADIATION PRESERVATION OF FOODS PROGRAM. Report No. 7 [for] November 29, 1958–January 28, 1959. G. B. Pratt and A. C. Wilbur. 19p. Project No. 7-84-01-002. Contract DA-19-129-QM-968.

In general, irradiated foods were found to affect enamels differently than their thermally processed counterparts. For some food products, the conventional enamel system must be replaced by new systems if the food is to be irradiated. In other cases, however, the enamel may be less adversely affected by the irradiated product than by the thermally processed product. The results of examination of cans of irradiated and thermally processed foods led to the conclusion that satisfactory enamels are available for irradiated cherries and chili-con-corne. Some enamel systems have also proven satisfactory to date for irradiated beef, codfish, and pork. (C.H.)

19271 AD-229218

Michigan State Univ., East Lansing.
ENZYME INACTIVATION STUDIES ON IRRADIATION STERILIZED MEAT. Report No. 6 (Progress) [for] Period: February 12, 1959–April 11, 1959. A. M. Pearson. 8p. Project No. O.I. 6118. Contract DA19-129-QM-1144.

Results are reported on the effect of pre-irradiation enzyme inactivation temperatures and storage from the standpoint of pH and amino nitrogen changes. Results of pre- and post-enzyme inactivation storage are reported with irradiated beef for pH and amino nitrogen transformations. (auth)

19272 AD-230301

Reliable Packing Co., Chicago.
EFFECT OF IRRADIATION ON CANNED PORK PRODUCTS. Report No. 5 (Progress) [for] Period: February 1, 1959–April 30, 1959. John E. Thompson. 5p. Project 7-84-01-002. Contract QMR&E (NATICK) No. 50 (Agreement).

No undesirable odor or flavor developed in irradiated canned smoked pork. Increased smoking time gave no improvement in product quality. (C.H.)

19273 AD-230303

Oregon State Coll., Corvallis, School of Agriculture and Oregon. Agricultural Experiment Station, Corvallis.
INCREASING THE ACCEPTANCE OF IRRADIATED MEAT AND MEAT PRODUCTS BY SELECTED TREATMENTS, BEFORE, DURING AND FOLLOWING IRRADIATION. Report No. 11 (Progress) [for] Period: January 27, 1959–April 26, 1959. H. W. Schultz. 8p. Project 7-84-01-002. Contract DA19-129-QM-836.

Beef heated to 170°F , radiated 3 megarad, and stored 180 days at 72°F was not different from reference samples at any period during storage. Heating at temperatures of 130 to 170°F did not result in differences until 45 days storage. Continued storage resulted in greater differences. Beef heated to 160°F was not significantly different in radiation flavor, bitterness or over-all desirability until the 120th day of storage. (auth)

19274 AD-230305

Oregon State Coll., Corvallis School of Agriculture and Oregon. Agricultural Experiment Station, Corvallis.
DEVELOPMENT OF IRRADIATION STERILIZED SHELF-STABLE FISH AND SEAFOOD PRODUCTS. Report No. 1 (Progress) [for] Period: January 12, 1959–April 11, 1959. H. W. Schultz. 2p. Project 7-84-01-002. Contract DA19-129-QM-1356.

Frozen breaded seafoods were irradiated at 1.5, 3.0, 4.5 megarad. All products seemed to be acceptable, with the exception of breaded shrimpsticks, at all levels of radiation. Gamma radiation at 4.5 megarad destroyed approximately 10 percent of the antioxidant. (auth)

19275 AD-230309

Denver and Rio Grande Western Railroad Co., Denver.
USE OF IONIZING RADIATIONS TO PRESERVE FRUITS AND VEGETABLES. Report No. 4 (Progress) [for] Period: February 1, 1959–April 30, 1959. Ray McBrien. 4p. Project 7-84-01-002. Contract QMR&E (Natick) No. 58.

Data are tabulated on the effects of gamma and ultraviolet radiation on the storage life and mold inhibition of oranges. A two- to three-fold extension of storage time was accomplished with 2.5×10^5 rads gamma exposure. Ultraviolet radiation produced excellent results on mold inhibition, skin color, and taste. (C.H.)

19276 AD-231950

Oklahoma State Univ., Stillwater.
DETERMINING THE EFFECT OF ANIMAL MATURITY AND FAT DISTRIBUTION ON THE QUALITY OF IRRADIATED BEEF. Report No. 5 (Progress) [for] Period: December 6, 1958 to June 5, 1959. R. L. Henrickson. 12p. Project 7-84-01-002. Contract DA19-129-QM-1033.

Ground beef and *longissimus dorsi* steaks from 24-month old animals are being evaluated for irradiation flavor. The fat content of the two lots of ground beef are 6.8 and 31.8%. Samples from animals 6 months old are also being evaluated. The fat content being studied is 6.9 and 27.3%. Taste panel data do not indicate major difference in flavor among steak from different animals of similar breeding. However, there did appear to be some difference in irradiation intensity. Aging the steak before irradiation did not greatly improve the flavor of the irradiated product. Irradiation does however make beef more tender. When cystine was irradiated in pure solution, carbonyls were found to be present in greater quantities than in non-irradiated cystine. Ammonia was also found to increase as the concentration was increased. Various cultures of bacteria were isolated from *longissimus dorsi* steak broiled at 150°F and irradiated with 5×10^6 rads of gamma rays. (auth)

19277 AD-231952

Michigan State Univ., East Lansing.
DIP COAT PACKAGING OF IRRADIATED FOODS. Report No. 6 (Progress) [for] March 15, 1959–May 14, 1959. L. J. Bratzler. 5p. Project No. 01-6169. Contract DA-19-129-QM-1195.

Results are tabulated from tests on cellulosic material of interest as packaging for irradiated foods. (C.H.)

19278 AD-232452

Massachusetts Inst. of Tech., Cambridge. Div. of Industrial Cooperation.
EVALUATION-DEVELOPMENT OF THE CONCURRENT RADIATION DISTILLATION TECHNIQUE AND INACTIVATION OF ENZYMES IN IRRADIATED FOODS. Report No. 8 (Progress) [for] July 21, 1958–September 20, 1958. B. E. Proctor. 33p. Project No. 7-84-01-002. Contract DA-19-129-QM-905.

The use of concurrent radiation-distillation techniques was evaluated as a research tool for characterizing the volatile flavor compounds from irradiated meat and milk products. Volatile compounds having significance to taste and odor were trapped, isolated, and identified. The effects of process variables on the storage qualities of radiation-sterilized milk were also investigated. (C.H.)

19279 AD-232577

Michigan State Univ., East Lansing.

ENZYME INACTIVATION STUDIES ON IRRADIATION STERILIZED MEAT. Report No. 2 (Progress) for June 12, 1958–August 11, 1958. A. M. Pearson. 9p. Project No. 7-84-01-002. Contract DA-19-129-QM-1144.

Progress is reported on the effect of pre-irradiation enzyme inactivation on flavor and texture of pork and beef. Initiation of studies on pre- and post-enzyme inactivation storage on flavor and texture of irradiated beef and pork roast is reported. Results of two methods of cookery upon taste test scores are reported. (auth)

19280 AERE-R-3027

United Kingdom Atomic Energy Authority. Research Group. Wantage Radiation Lab., Harwell, Berks, England.

INVESTIGATION INTO THE POSSIBILITY OF USING RADIOACTIVE TRACER METHODS FOR TESTING FILTERS. Jillian W. Webb. Apr. 1960. 33p. BIS.

Radioactive tracer techniques offer alternative methods to those normally employed for testing filters and measuring their efficiencies. An investigation into the possibilities of applying radioactive isotopes to measurements on filters used with liquids is described. Using a technique described in this report, measurement of filter efficiencies agreed to within $\pm 0.5\%$ with those obtained by microscope analysis. The time required to make an analysis compares favorably with the established methods. (auth)

19281 NP-8889

Michigan. Univ., Ann Arbor. Medical School.

DETERMINATION OF RADIATION STERILIZATION DOSE FOR CANNED MEAT. Report No. 13 (Final) [for] August 1, 1957–November 30, 1959. L. L. Kempe and J. T. Graikoski. Nov. 1959. 122p. Project No. 7-84-01-002. Contract DA-19-129-qm-964.

Canned ground beef containing 5,000,000 *Clostridium botulinum* spores per gram were sterilized with between 3.80 and 3.85 megarad of gamma rays. Botulinus toxin was regularly found in irradiation-sterilized and incubated cans of ground beef inoculated with 2,870,000 or more *Clostridium botulinum* 62A spores per gram. The lethality of gamma rays for *Clostridium botulinum* spores was found to be slightly dependent upon both the temperature during irradiation and the intensity of the radiation field. Canned peas, inoculated with *Clostridium botulinum* spores, were more easily sterilized with combined irradiation-heat processing than by either form of energy alone. (auth)

19282 NYO-2490

United States Radium Corp., Bloomsburg, Penna.

DEVELOPMENT OF KRYPTON-85 STATIC ELIMINATION EQUIPMENT. Final Report. F. Palmeri, Jr., H. P. Copeland, and J. G. MacHutchin. Jan. 1960. 92p. Contract AT(30-1)-2306. OTS.

An investigation was made of various factors which influence the efficiency of linear type Kr⁸⁵ static eliminator units. Among the variables examined were source tube material, Kr⁸⁵ content, housing configuration, distance of source from charged surface, plus area and potential of charged surface. Based on the experimental results, a

prototype Kr⁸⁵ static eliminator unit was designed, fabricated, and tested. The essential design features are described. The relative ionizing efficiencies of encapsulated Kr⁸⁵ gas and Ra²²⁶ foil were determined. Under the experimental conditions employed, it was found that 350 mc Kr⁸⁵, encapsulated in 0.0035 in. wall aluminum alloy tubing, produces ionization approximately equivalent to that for a 1 mc Ra²²⁶ foil. This relationship applies when the Kr⁸⁵ source tube is mounted in the prototype housing and the Ra²²⁶ foil in a commercially available housing. Radiation profiles were determined for a number of sources. The effect of various exterior shielding on radiation profiles is illustrated. (See also AECU-4363.) (auth)

19283 TID-6044

Goodyear Tire and Rubber Co., Akron, Ohio.

ISOTOPIC METHOD FOR AGE DETERMINATIONS OF INDUSTRIAL PRODUCTS. Quarterly Progress Report [for] January–March 1960. T. C. Gregson and L. B. Bangs. 28p. Contract AT(11-1)-719. OTS.

The principle of the method with isotope pairs dispersed in product material, the feasibility of conducting age measurements with exempt concentrations of isotopes, and the practicality of using commercially available internal liquid scintillation counting equipment for age determinations were investigated for age determination of industrial products. (W.L.H.)

19284 TID-6151

Chicago. Univ. Chicago Midway Labs.

THE APPLICATIONS OF ISOTOPES TO INDUSTRIAL PROBLEMS. Progress Report Letter No. 15 for the period May 16 to June 15, 1960. Foster F. Rieke. June 20, 1960. 11p. Contract AT(11-1)-712. (LAS-L-P161-15). OTS.

Work is starting on the study of wear and lubrication of piston rings. Data are reported on density and moisture content of coal in storage. (W.L.H.)

19285 WADC-TR-59-659

Arkansas. Univ., Little Rock. Graduate Inst. of Tech.

USE OF RADIOACTIVE IODINE VAPOR FOR DETERMINING SURFACE ROUGHNESS. M. K. Testerman. Dec. 1959. 47p. Project No. 7022. Contract AF33(616)-5541. OTS.

Several relative roughness factors of gold, brass, and aluminum surfaces, exhibiting varying degrees of surface roughness, were determined by utilizing I¹³¹ vapor as an adsorbate. Polished gold foil, possessing a high degree of purity, was used as a reference surface. A roughness factor of one was chosen arbitrarily for this reference surface, and all roughness factors contained are relative to this value. The roughness factors obtained for brass were decidedly higher than those obtained for other metals. Hence, it was concluded that a chemical combination resulted from the adsorbed layer of I¹³¹ on the brass surface accounting for the higher specific activity obtained. Figures and illustration describing the experimental equipment are given, as well as data tables and other information pertinent to the previously-mentioned roughness factors. (auth)

19286 JPRS-2765

THE RESULTS OF TESTING THE GAMMA MOISTURE GAUGE IVP-64. Yu. S. Mel'nik. Translated from Meteorol. i Gidrol. No. 2, 35-8(1960). 11p. OTS.

A radioactive method is described for measuring the change in the quantity of moisture in the soil by the degree of gamma-ray attenuation. The precision of soil-moisture determination by the gamma moisture gage depends on the stability of the operation of the conversion device. The gamma moisture gage was used to determine moisture in a

fallow field and a field of winter wheat with a precision of 2 to 5 mm. (W.L.H.)

19287

THE USE OF RADIOACTIVE ISOTOPES FOR THE MEASUREMENT OF THE MOISTURE CONTENT OF STEAM.

M. I. Korsunskii, A. S. Lagunov, L. P. Baivel', and A. N. SineI'nikov. *Izmeritel'naya Tekh.* No. 5, 50-2(1960). (In Russian)

A method for continuously measuring the moisture content of steam was tested. The possibility of measuring the average moisture content without sampling and independent of droplet size in the stream was demonstrated. The relative change in intensity of a beam of beta particles from a S^{35} source passing through the stream was used to determine the density of the stream. Moisture content was then obtained by comparing the measured density with tabulated values of density of saturated dry steam. Measurements were taken at a steam velocity of 150m/sec. Description and drawings of the apparatus are included. The apparatus allows measurement of density with steam velocities from 5 to 200 m/sec, moisture content from 0 to 15%, temperature variations from 70 to 180°C, and pressure variations from 1 to 0.1 atmospheres. Also the mass absorption coefficient of beta particles was determined from measurements of the relative beam intensity versus thickness of the absorbing steam; in superheated steam the value is 197 cm²/g. (TTT)

19288

A NEW APPARATUS FOR THE RADIOMETRIC DETERMINATION OF THE ASH CONTENT OF COAL BY GAMMA RAY ABSORPTION. Rudolf Jirkovsky (School of Tech., Moravská Ostrava, Czechoslovakia). *Jaderná energie* 6, 63-4(1960). (In Czech.)

A self-contained, shielded apparatus which presents no radiation hazard during operation was used for the rapid and economical execution of radiometric analyses of the ash content of coal at the mine or coke processing plants. Tl-204 and Tm-170, with γ radiations of 0.076 Mev and 0.084 Mev, were used successfully as the source of the radiation; but Th-232, Eu-153, and Se-75 are proposed for future use. The source is contained in a shielded Pb collimator, while the sample holder consists of a Plexiglas disc, which can be rotated bringing the individual units into position over the collimator slit. A shielded G-M tube, fastened over the opening of the cover box is used as a detector. About 5 g of dry, pulverized coal are used for the individual determinations. Readings are checked against a calibration curve obtained with standardized samples with known mineral ash content. A scaler or a scintillation detector with a photomultiplier may be used. The values of I_{γ}/I_e (Mev) plotted against the mineral ash content yields a linear curve from very low values to 25% ash content with a precision of 0.4%. The entire analysis may be completed in 6 min, thus being superior to equipment designed by V. D. Gorosko (*Vestnik Acad. Nauk SSR*, 79, No. 2, 1956) which utilizes wet samples of powdered coal and requires 40 min. (TTT)

19289

THE DEVELOPMENT OF AUTOMATIC CONTROL METHODS USING NUCLEAR RADIATION. N. N. Shumilovskii and L. V. Meltser. *Vestnik Akad. Nauk S.S.S.R.* 30, No. 3, 42-6(1960) Mar. (In Russian)

In 1958 automatic control methods using nuclear radiation saved the economy of the U.S.S.R. 500 million rubles in increased production and decreased operating costs. It is estimated that broader application of existing methods and equipment can yield annual savings of four billion

rubles. The sources of error in control devices using radiation are discussed, and two basic schemes for reducing error are described. Both are based on comparison of signals and on mechanical followers or indicators. A third system that eliminates mechanical followers through the use of a dynamic calibrating signal is also discussed. The relationship of error in measurement of radiation current to error in the controlled technological parameter is discussed and is given as $\delta x = \delta J / x [\ln(x)]'$ where J is current, x is the controlled parameter, and $J = f(x)$. It is shown that to obtain a minimum δx when controlling thickness through gamma scattering, $\mu + \mu_s = 0.7$ is the required relationship of mass attenuation coefficient and scattered gamma mass attenuation coefficients. For control of thicknesses through back scatter of beta rays, $kpt = 1$ for minimum δx . Control problems in which the intensity of radiation does not have to be measured accurately are also discussed. One of the principal goals cited is the continuous and contactless control of the composition of complex mixtures. The need for a national laboratory to attack this and similar problems is discussed. (TTT)

19290

THE ABSORPTION OF Co^{60} BETA RAYS IN REFRACTORY MATERIALS. D. M. Shakhin and V. D. Kovalev (Ukrainian Research Inst. for Refractory Materials, USSR). *Zavodskaya Lab.* 26, 173-5(1960). (In Russian)

The mass absorption coefficients of BeO, MgO, CaO, Al_2O_3 , Cr_2O_3 , Fe_2O_3 , SiO_2 , TiO_2 , and ZrO_2 were measured and compared with calculated values. The mass absorption coefficients of "Chromite I," "Chromite II," and "Chromomagnesite" (refractory mixtures based on Cr_2O_3) were experimentally determined and compared with calculated coefficients based on the coefficients of the constituent oxides. Good agreement was obtained. A discussion of the effect of chemical bonds on absorption coefficients is given, and the use of measured values only in industrial applications, with well defined geometries of source, absorber, and counter, is recommended. (TTT)

ISOTOPE SEPARATION

19291

THE ENRICHMENT OF WATER IN H_2O^{18} BY LIQUID THERMAL DIFFUSION. Gilbert S. Panson and Patrick B. Sullivan (Rutgers Univ., Newark, N. J.). *J. Phys. Chem.* 64, 825-7(1960) June.

Isotopic fractionation of H_2O^{18} by thermal diffusion was studied with water initially containing 0.2 and 1.6 at.% H_2O^{18} . The experiments were carried out between plates separated by 0.25 mm and with a temperature difference of 55°C for a period of 2 to 7 days. Aliquot samples were then equilibrated with CO_2 , and the CO_2 was analyzed with the mass spectrometer for CO_2^{18} . The $H_2O-H_2O^{18}$ enrichment ratios, while too small for use in large scale separation of H_2O^{18} , are on the same order as those for H_2O-D_2O separation and, like the H_2O-D_2O system, indicate that enrichment decreases with higher H_2O^{18} concentrations. (D.L.C.)

19292

GAS-SOLID CHROMATOGRAPHY OF H_2 , HD, AND D_2 . ISOTOPIC SEPARATION AND HEATS OF ADSORPTION ON ALUMINA. William R. Moore and Harold R. Ward (Massachusetts Inst. of Tech., Cambridge). *J. Phys. Chem.* 64, 832(1960) June.

Good gas chromatographic separation of H_2 , HD, and D_2

was obtained with alumina coated with ferric oxide and partially deactivated with CO_2 . The range of D_2 concentration determinable in this way with ca. 0.2% deviation is 1 to 99%; HD can be detected in H_2 or D_2 at 0.01% or less. Alumina with adsorbed O_2 was also found to be good for H_2 -HD- D_2 separation, but partial deactivation with CO_2 restores ortho-para separation, whose peaks interfere with the above separation. It appears that ferric oxide and O_2 produces rapid ortho-para equilibration, thus facilitating H_2 -HD- D_2 separation. Limiting isosteric heats of adsorption on alumina and differences between the heats of adsorption of ortho-para isomers are reported. (D.L.C.)

19293

MASS-SPECTRUM LINE SHAPE AND THE ROLE OF PULSE ION SOURCE IN RADIOFREQUENCY MASS SPECTROMETER. E. M. Kuchkov (U'yanov (Lenin) Leningrad Electrotechnical Inst.). *Zhur. Tekh. Fiz.* 30, 568-72(1960) May. (In Russian)

Equations were derived for simplifying the analysis of radiofrequency mass spectrometers. The equations were derived for mass-lines in the absence of spread. The maximum performance of radiofrequency devices with and without consideration of pulsed source is shown. (tr-auth)

19294

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF HEAVY WATER. (to Junta de Energia Nuclear). British Patent 837,894. June 15, 1960.

A process is described for the production of heavy water by a cascade system of electrolytic cells. (W.L.H.)

MATHEMATICS AND COMPUTERS

19295 KAPL-1999

Knolls Atomic Power Lab., Schenectady, N. Y.
UFO: A THREE-DIMENSIONAL NEUTRON DIFFUSION CODE FOR THE IBM 704. E. H. Auerbach, J. P. Jewett, and M. A. Ketchum. Mar. 24, 1959. 64p. Contract W-31-109-Eng-52. OTS.

A description of UFO, a code for the solution of the few-group neutron diffusion equation in three-dimensional Cartesian coordinates on the IBM 704, is given. An accelerated Liebmann flux iteration scheme is used, and optimum parameters can be calculated by the code whenever they are required. The theory and operation of the program are discussed. (auth)

19296 KAPL-M-JA-8

Knolls Atomic Power Lab., Schenectady, N. Y.
EQUATIONS FOR THE WOXX CROSS-SECTION ROUTINE OF THE KARE SYSTEM. J. A. Archibald, Jr. May 31, 1960. 63p. Contract W-31-109-Eng-52. OTS.

Equations for the WOXX cross-section routine of the KARE system, a two-dimensional few-group neutron diffusion code, are presented. WOXX is a program that obtains macroscopic cross sections averaged over a hardened Maxwellian plus an inverse energy neutron spectrum. The cross sections obtained are for three groups only. The cutoff energy between the thermal and epithermal group varies between 0.4 and 0.08 ev. The cutoff between the epithermal and fast groups is fixed at 0.18 Mev. (C.J.G.)

19297 KAPL-M-SW-1

Knolls Atomic Power Lab., Schenectady, N. Y.
HEXFIT, A DATA REDUCTION CODE FOR CYCLICALLY COUNTED SAMPLES. S. Weinstein, A. D. Musto, and F. Feiner. May 11, 1960. 7p. Contract W-31-109-Eng-52. OTS.

The HEXFIT, a data reduction code for cyclically counted irradiated samples, is described. (C.J.G.)

19298 NAA-SR-Memo-4220

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
THE HEMAD CODE. B. L. Scott. Aug. 5, 1959. 12p. OTS.

Instructions on the use of HEMAD code are presented. This code is used to compute the energy spectrum of neutrons in an infinite, homogeneous lattice in the heavy moderator approximation and to average specified quantities over such spectrum. (J.R.D.)

19299 NP-8851

Stanford Univ., Calif. Applied Mathematics and Statistics Lab.

APPLICATIONS OF SEMI-MARKOV PROCESSES TO COUNTER AND RELIABILITY PROBLEMS. Technical Report No. 57. Richard Barlow. Apr. 29, 1960. 96p. Contract N6onr-25140.

Counter and reliability problems were solved using the technique of the embedded semi-Markov process. The determinantal properties of I-P, where P is the transition matrix associated with the semi-Markov process, were related to the stochastic properties of the embedded Markov chain. The first and second moments of the first passage distribution for a finite process were obtained. A new feature of the technique was input processes which were in general non-renewal. The reason for generalizing the input process was that the renewal input assumption was not always realized. A unified treatment was made of a large class of so-called "repairman problems" which arose in reliability theory. These problems were identified with appropriate stochastic models from queueing and telephone trunking theory. (M.C.G.)

19300 SCR-159

Sandia Corp., Albuquerque, N. Mex.
A CONFIDENCE-LIMIT COMPUTER. Joseph O. Muench. Apr. 1960. 10p., 1 illus. OTS.

A paper computer is presented for finding the fourth from three known variables: upper confidence limit, confidence level, number of observations, and number of events with a specified characteristic. Complete instructions for computer operation are given. (D.L.C.)

19301 TID-6168

Illinois. Univ., Urbana.
A STUDY OF REDUNDANT NUMBER REPRESENTATIONS FOR PARALLEL DIGITAL COMPUTERS (thesis). Report No. 101. Algirdas Avizienis. May 20, 1960. 82p. Contract [AT(11-1)-415]. OTS.

The effects of redundancy in each digital position of a number representation for arithmetic operations in parallel digital computers were investigated without the use of a carry-borrow identification. In the approach employed, a method of addition which has the desired properties is initially postulated and from this description the properties of a number representation which permits the postulated method of addition were derived. A totally-parallel mode of addition is defined and postulated to be the required characteristic of a number representation. A class of signed-digit number representations which permit totally-parallel addition is developed. Various significant properties of these signed-digit representations are developed and the existence of methods for the executions of arithmetic operations is demonstrated. The logical design of an adder circuit for totally-parallel addition of two numbers in signed-digit representation is discussed. (C.J.G.)

19302 WAPD-BT-18(p.99-105)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

CRIT-1—CRITICAL VELOCITY CODE. C. M. Friedrich and R. S. Pyle. p.99-105 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

Bettis code CRIT-1 was developed to calculate critical flow velocities for a nuclear reactor subassembly with rectangular water channels and flat fuel plates. This IBM-704 FORTRAN program combines an isothermal single-phase pressure drop routine with a rib mesh deflection routine to determine plate deflection vs. flow velocity. The required input data, flow diagrams, and theory are discussed. (auth)

19303

THE DEVELOPMENT OF NUCLEAR CODES IN JAPAN.

[PART] I. Tasaburo Yamade (Japan Nuclear Codes Group, Electro-Technical Lab., Japan) and Toshio Aoki (Japan Atomic Energy Research Inst., Tokyo). *J. Atomic Energy Soc. Japan* 2, 343-52(1960) June. (In Japanese)

The history of code and computer development and usage in Japan is briefly reviewed. Applications of codes in studies of neutron group diffusion, fuel burnup, reactor kinetics, neutron spectra, neutron transport, Monte Carlo method, and shielding are described. Tables are included which indicate the establishments doing code and computer research, the date various codes were introduced and their purpose, the characteristics of domestic computers, and programs for shielding codes. (D.E.B.)

19304

GRAPHICAL METHOD OF INTERPOLATION. A. A.

Rudnitskii. *Zhur. Neorg. Khim.* 5, 396-400(1960) Feb. (In Russian)

A simple graphical method is proposed for plotting curves from experimental data. The value of the function or the argument can be accurately obtained without resorting to complicated mathematical calculations. The method is useful in the interpolation and determination of the relationship between some physical property versus temperature, particularly in the calibration of thermocouples and resistance thermometers. Detailed calculations are presented. Thus, from a series of experimental points of the specific electrical resistance of iridium, a table was constructed for each 100° from 0 to 1700°C. Calibration of the temperature of a platinum-platinorhodium thermocouple is carried out. The thermoelectromotive forces registered at the melting points of ice, naphthalene, Sn, Pb, Zn, Sb, and Cu are used as reference points. The data are then calculated to show thermoelectromotive force versus temperature for each 100° from 100 to 1100°C. Examples of converting pyrometer readings to temperature are presented. Readings of a platinum resistance thermometer can be readily converted to temperature. (TTT)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

19305 AD-231565

Westinghouse Electric Corp. Research Labs., Pittsburgh. THERMOELECTRICITY QUARTERLY PROGRESS REPORT NO. 4. Nov. 18, 1959. 78p. Contract NOBS-77043.

Rapid strides were made in the field of thermoelectric power generation in that the theoretical efficiencies in the

temperature range 300 to 1075°K were increased 25% over the values of a year ago. This increase was due in part to the following: (1) improved doping techniques increased the figure of merit and the useful temperature range of the $\text{Bi}_x\text{Sb}_{2-x}\text{Te}_y\text{Se}_{3-y}$ system; (2) partial replacement of Ge by Bi as a solution for the over doping of GeTe occurring at the low end of the useful temperature range increased the contribution of GeTe to the efficiency; (3) the introduction of P into InAs improved the figure of merit at the low temperature end of the useful range of this material; and (4) N-type PbTe was developed in both the cast and sintered forms. Significant advances were made in materials suitable for operations up to 1500°K. Among the more interesting of these materials are the chalcogenides (S, Se, Te) of the rare earth elements. Studies are in progress on both Ce and Sm, typical narrow band conductors. Recent work shows that thermal conduction by radiation should give no problems in the narrow band materials. Effort was devoted to the development of powder metallurgy techniques, which were successful for Bi_2Te_3 , GeTe $\text{Ge}_x\text{Bi}_{1-x}\text{Te}$, and PbTe. (auth)

19306 AD-232710

Standard Pressed Steel Co., Jenkintown, Penna.

BERYLLIUM FASTENER PROGRAM. Interim Engineering Report No. 1 [for] Report on Lot A of Phase I from June 12, 1959 to December 31, 1959. Thomas C. Baumgartner and Edward F. Gowen, Jr. Dec. 30, 1959. 49p. AMC Project No. 7-807. Contract AF33(600)-39728.

A program established to determine the feasibility of fabricating threaded fasteners from beryllium is described. The use of this material in fasteners could achieve a substantial weight saving in structures. One lot of $\frac{5}{16}$ and $\frac{1}{4}$ NAS 464 bolts were made from bar stock obtained from two sources. These fasteners were fabricated using normal bolt production methods. After completion and testing, a second lot, in the same sizes are to be made to improved dimensions by fabrication methods more adaptable to beryllium. The results of inspection of raw bar stock, fabrication operations, and mechanical tests are included. (auth)

19307 AD-234944

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.

PROTECTIVE COATINGS FOR MOLYBDENUM ALLOYS. Quarterly Report No. 3 Covering Period October 1-December 31, 1959. 34p. Contract NOas 59-6026-C.

Three commercial molybdenum coatings prepared by Climax, Linde, and Chromalloy were evaluated by metallographic techniques and x-ray-diffraction analysis. The mode of failure was analyzed and related factors of modulus of elasticity, adherence, hardness, and particularly thermal expansion were discussed. Studies were made on the phase change that occurred in the flame spraying of alumina and mullite. X-ray-diffraction analysis was used to evaluate the alpha to gamma and reversible phase transformation in alumina as well as the devitrification of amorphous mullite which was produced by flame spraying. The use of niobium and tantalum as an intermediate bond layer between molybdenum and ceramic coatings was analyzed on the basis of oxidation and alloy compatibility. A study of the alumina-glass and mullite-glass coating on molybdenum was made. These coatings were evaluated by oxidation tests at 2300°F where oxidation occurred in a short period of time. A small micro observation furnace was constructed and used for the studies of wetting, adherence, and inter-reaction between glass, oxide, and refractory metal specimens. (auth)

19308 ANL-5709

Argonne National Lab., Ill.

METALLURGY DIVISION QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, AND DECEMBER 1956. Dec. 31, 1956. Decl. Feb. 4, 1960. 64p. Contract W-31-109-eng-38. OTS.

Progress is reported on the following studies: the fabrication, testing, and evaluation of the Experimental Boiling Water Reactor fuel elements; fabrication of ThO_2 - UO_2 fuel pellets; fabrication of fuel and blanket rods for the Experimental Breeder Reactor; properties and irradiation of uranium-plutonium-fissium alloys; corrosion of Al alloys in phosphoric acid; aqueous corrosion of Ta-U-Zr alloys at 290°C; effect of radiation on the corrosion behavior of the Si-U system; dimensional stability of U-Zr alloys under irradiation; the effects of radiation on uranium hydride compacts; the recrystallization of cold-rolled U sheet annealed at various temperatures; self-diffusion in U; phase studies and decarburization of C-U systems; preparation of α -uranium single crystals for elastic constants; sintering of ceramic materials; corrosion mechanisms of Zr and Al at elevated temperatures; and radial distribution of neutron density in reactor fuel rods. (W.L.H.)

19309 ARDE(MX)-13/59

Gt. Brit. Armament Research and Development Establishment, Fort Halstead, Kent, England.

PURIFICATION OF MOLYBDENUM DURING VACUUM MELTING. THEORETICAL CONSIDERATIONS. B. B. Argent. July 1959. 33p. (AD-234247).

Methods of removing unwanted interstitial solutes from molybdenum during vacuum melting are discussed. Available thermochemical data are reviewed, and its application to production of ductile metal is assessed. The carbon-oxygen reaction which appears best for forming compounds which can be removed from the melt are most fully discussed. (J.R.D.)

19310 BMI-1189

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY 1957. Russell W. Dayton and Clyde R. Tipton, Jr. June 1, 1957. Decl. Feb. 4, 1960. 59p. Contract W-7405-eng-92. OTS.

Data are reported on the creep properties of annealed Zircaloy-2 and -3A. Efforts directed toward the improvement of the extrusion-cladding process were continued. A program of research concerned with the development of melting and casting techniques for the production of sound, homogeneous Al-U extrusion billets containing up to 50 wt.% U is in progress. Uranium oxides are being studied to determine how processing variables affect the reactivity of the dioxide in subsequent steps in the production of U. The study of the effects of N_2 on the electrical properties of UO_2 was continued. Investigations were continued on the corrosion of Type 304 ELC stainless steel by chloride- and fluoride-contaminated HNO_3 solutions such as might occur during the recovery of HNO_3 from U processing plants. Hydrogen pickup by U rods heat treated in pilot-plant-scale beta heat-treating salt baths is being studied. The compacting of briquettes of UF_4 and Mg was offered as a means of improving the efficiency of the bomb-reduction process. Nuclear fuel elements utilizing the refractory materials BeO and graphite as matrices for UO_2 are being investigated. Data are reported on the tensile properties of U-Nb alloys containing 7, 10, and 15 wt.% Nb. The mechanism of aqueous U corrosion is being studied in order to develop corrosion-resistant alloys for reactor fuels. Research on the fundamental properties, corrosion resistance, and radiation resistance of U-Zr alloys is reported. Long-term

corrosion studies pertaining to the development of corrosion-resistant Zr and Zr-base alloys were continued in elevated-temperature water and steam. Data are reported on the oxidation behavior of binary Nb alloys tested in air at 1000°C. Tensile test data are presented for martensitic U-Ti alloys. The reaction of oxygen and nitrogen with USi_3 , U_3Si_2 , USi_2 , USi , and UAl_2 was investigated. Investigations of corrosion problems associated with the recovery of spent reactor fuel elements were continued. A reflector method of control for a boiling-water heterogeneous reactor is being investigated. The behavior of Ta exposed to 1200°F peak-temperature sodium is being investigated using forced-convection flow-loop apparatus. Creep testing of annealed Ta sheet was continued. A new and particularly sensitive method for the determination of oxygen in sodium is being developed. (For preceding period see BMI-1181.) (W.L.H.)

19311 BMI-1442(Rev.)

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY 1960. Russell W. Dayton and Clyde R. Tipton, Jr. July 12, 1960. 100p. OTS.

The investigation of the stabilizing influence of oxide additions to UO_2 was continued. The effects of fast-neutron irradiation upon the mechanical properties of Type 347 stainless steel are being investigated. Tensile data are reported for alloys of Nb-Cr and Nb-Zr. The major effect of fast-neutron irradiation on the creep properties of Zircaloy-2 is being studied by comparing the in-reactor creep behavior of the alloy with out-of-reactor creep properties. New methods for the determination of low concentrations of oxygen in sodium are being investigated. The mechanisms of wear and friction of various metals in sliding contact in liquid sodium are being studied. Data are presented on corrosion properties, short-time tensile properties, stress-rupture properties, and electrical resistivity for Nb-U alloys. The development of Th and Th-U alloys with improved radiation resistance is being investigated. A program is reported for the determination of diffusion coefficients of Xe in single-crystal UO_2 specimens and the in-pile study of fission-product release from sintered UO_2 . Thermal-conductivity, thermal-expansion, electrical-resistivity, and modulus-of-rupture measurements are being made on 80 vol. % UO_2 cermets. Techniques for the fabrication of compartmented Mo- and Nb-clad UO_2 and cermet fuels are being investigated. Compaction studies of UO_2 were undertaken to provide core materials which will achieve a range of desired densities on pressure bonding. The fabrication of Type 304 stainless steel-clad UO_2 rod, tube, and flat-plate elements and flat-plate assemblies was accomplished by gas pressure bonding. Various methods for economically producing dense UC components by powder-metallurgical techniques are being investigated. A study of the properties of UC is under way. Thermal-gradient experiments are being performed to establish a theoretical basis for the prediction of hydrogen migration in zirconium hydride. Experiments were continued in producing single crystals of UO_2 . Portland cement samples were analyzed for sulfate content using a radiometric method involving the precipitation of $\text{Sr}^{88}\text{SO}_4$. Solution-annealed strips of welding alloys for use with Hastelloy F to contain decladding solutions were prepared for welding and corrosion evaluations. A study is being made of the effects of irradiation on cladding- and core-dissolution processes. Uranium carbide shot was coated with 160 μ of carbon by the thermal decomposition of acetylene in a fluidized bed of the shot. Two programs concerned with investigations of Ta and Ta-base materials

of interest for containment of molten Pu-alloy fuels are under way. Fission-gas release from $\text{BeO}-\text{UO}_2$ is being investigated by heat treating neutron-activated sintered pellets. A study of the radiation stability of ceramic-type fuels under conditions simulating those of the MGCR design is in progress. Further experimental and theoretical studies were carried out to determine the feasibility of coating and preparing U and Th carbides by vapor deposition reactions in a fluidized bed. Methods are being developed for preparing instrumented fuel plates for use in SM-1 type fuel elements for in-pile test evaluation. Materials were selected and techniques were established for the fabrication of SM-2 reference fuel elements. For the ML-1 Reactor Hastelloy X will be used as the fuel-element cladding material. (For preceding period see BMI-1434.) (W.L.H.)

19312 CF-57-2-93

Oak Ridge National Lab., Tenn.

METALLOGRAPHIC EXAMINATION OF ORNL NO. 1, SHE NO. 2. J. E. VanCleve, J. H. DeVan, and R. S. Crouse. Feb. 7, 1957. Decl. Oct. 9, 1959. 13p. OTS.

Small Heat Exchanger ORNL No. 1, type SHE No. 2, was removed from test stand B after 2071 hours of operation; 1041 hours were under ΔT conditions. The heat exchanger contained 20 Inconel tubes having an outside diameter of 0.25 in. and a wall thickness of 0.025 in. The outside of these tubes was exposed to the fluoride mixture $\text{NaF}-\text{ZrF}_4-\text{UF}_4$ (50-46-4 mole %), while the inside of the tubes contained NaK (44% Na-56% K). During ΔT conditions, the fluoride temperature entering the heat exchanger was 1310°F and on leaving was 1235°F. The temperature of the NaK entering the heat exchanger was 1050°F and at the exit was 1290°F. During isothermal operation, the temperature of both the NaK and fluoride circuits was 1300°F. Thirty-six temperature transitions from isothermal to ΔT conditions were made during the course of operation. An examination of the resistance heater used in conjunction with this heat exchanger also was made: the results are reported. (auth)

19313 CF-59-8-132

Oak Ridge National Lab., Tenn.

SURVEY OF ANODIZING PROCESSES FOR ALUMINUM. H. L. Holsoopple, Jr. Aug. 27, 1959. 9p. Contract [W-7405-eng-26]. OTS.

A preliminary survey of the literature concerning anodizing and oxide treatments for aluminum was made for the purpose of selecting a method of anodization which would produce, on aluminum, a 0.2-mil oxide film of high density with reasonable durability and abrasive resistance, and which would have high electrical insulating characteristics. A recommendation for further development is included. (auth)

19314 CF-60-4-118

Oak Ridge National Lab., Tenn.

CLADDING SURVEY FOR THE ENRICO FERMI REACTOR U-15 Wt.% Mo BASE DISPERSION-TYPE FUEL ELEMENT. M. M. Martin and R. J. Beaver. Apr. 29, 1960. 39p. OTS.

Potential cladding materials for a flat-plate fuel element containing a dispersion of UC or UO_2 in U-15 wt.% Mo alloy were surveyed on the bases of compatibility with the fissile compounds, matrix material, protective cover materials, and liquid sodium as well as the feasibility of fabricating fuel plates by roll cladding. Radiative-capture cross sections, thermodynamic data, eutectic and intermediate compound formation, mechanical properties, and corrosion by 1000°F Na are reported for austenitic stain-

less steels, chromium, nickel, niobium, molybdenum, tantalum, vanadium, and zirconium. It was recommended that "A" nickel (molybdenum barrier), Zr-3 wt.% Al, Nb-2 wt.% Cr, and Fansteel 82 be selected for investigation. (auth)

19315 CWL-SP-4-9

Chemical Warfare Labs., Army Chemical Center, Md.

FIFTH MATERIALS REVIEW. Arthur Lyem. Jan. 5, 1959. 88p. Project No. 4-93-30-001.

A review of materials research in the polymer and plastics fields is presented. Included is information on high polymers, plastic materials, synthetic fibers, metals and inorganic materials, and miscellaneous developments in a wide variety of subjects. (J.R.D.)

19316 LAMS-2401(Vol. I)

Los Alamos Scientific Lab., N. Mex.

BIBLIOGRAPHY ON TUNGSTEN, ITS ALLOYS AND COMPOUNDS. Lois E. Godfrey, Patricia E. Bell, and Helen S. Stearns, comps. July 1959. 208p. Contract W-7405-eng-36. OTS.

A bibliography, containing 1195 references, is presented on the properties, production, and methods of joining tungsten, its alloys, and its compounds. (C.J.G.)

19317 LMSD-288139(Vol. I, Pt. 2)(Paper 5)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STUDIES OF SPUTTERING BY BEAM TECHNIQUES. R. P. Stein and F. Hurlbut. Paper 5 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 2. 20p.

The general problem of low-energy sputtering of metallic surfaces is reviewed. An experiment designed to provide information on the detailed mechanism of the sputtering process and the experimental apparatus for this study are described. The initial results and their interpretation are presented. (auth)

19318 LMSD-288190(Suppl.1)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

BERYLLIUM—SURVEY OF THE LITERATURE. K. D. Carroll, comp. Apr. 1, 1960. 60p.

This first supplement to "Beryllium: A Search of the Literature, 1957-1959" contains a survey of the literature on beryllium grouped under the following headings: alloys, analysis and structure studies, applications, hazards and toxicity, joining methods, oxides and carbides, physical and chemical properties, processing and production, propellants, reactors and fuel applications, and working. (M.C.G.)

19319 LMSD-288234

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STUDIES OF THE GAS CARBURIZATION OF NIOBIUM. A. Ottenberg. Jan. 1960. 43p. Contract NOrd-17017.

This paper was originally printed under the same title in Vol. II, "Metallurgy and Chemistry," of General Research in Materials and Propulsion, January 1959-January 1960, LMSD-288140.

Studies were made on the gas-carburization of metallic Nb. Results indicate that the mechanism at the gas-solid interface proceeds through the formation of a chemical complex between the hydrocarbon gas and the surface. This action is followed by the stripping-off of H to yield a chemically bound C atom which can then diffuse into the interior. The reactive diffusion of the C into the interior yielded a hemicarbidic phase (Nb_2C) which enters the core

by intergranular penetration. A monocarbide phase (NbC) followed, which penetrated the hemiacarbide phase along a sharp boundary. The penetrations by the hemiacarbide and monocarbide phases proceeded simultaneously. The monocarbide phase was extremely brittle and did not adhere well. Formation of the hemiacarbide phase as an essentially pure adherent film on the metallic core was found possible. (auth)

19320 NAA-SR-Memo-3132

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
AUTOMATIC DE-CANNER—SRE FUEL ELEMENTS.
H. Schleim. Oct. 7, 1958. 5p. OTS.

A method for opening irradiated fuel element cans without cutting into the element was investigated. Design of a fuel element decanner which was used to open dummy fuel elements is described. Methods used in simulated runs are outlined, and sample calculations are included along with blueprints. (J.R.D.)

19321 NAA-SR-Memo-5025

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
BIBLIOGRAPHY ON FLAME COATING. F. R. Bennett and L. S. McCollum. Feb. 20, 1960. 20p. OTS.

Results of a literature search for all available information on flame coating and related subjects are presented. (auth)

19322 NAA-SR-Memo-5183

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
MATERIALS FOR RADIATOR-CONDENSER SHELL. J. C. Sells. Apr. 18, 1960. 18p. OTS.

An investigation was conducted to determine criteria for selection of SNAP-2 radiator-condenser shell material. Properties of applicable materials are included along with a list of the most promising materials. (J.R.D.)

19323 NP-8816

Reactive Metals, Inc., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN, AND ZIRCONIUM DIBORIDE. Quarterly Progress Report No. 8 [for] February 1–April 30, 1960. R. L. Martin, S. R. Seagle, and O. Berteau. May 1960. 21p. Contract AF33(616)-5603.

Progress is reported in electron beam melting of beryllium, hafnium, vanadium, cobalt, molybdenum, and tungsten. Deoxidation of metals by additions of other metals and carbon during electron beam melting is also being investigated. Results indicate that hafnium can be purified by electron beam melting. Elements that are removed by double electron beam melting are Al, Co, Cr, Cu, Fe, Ge, In, Li, Mg, Mn, Mo, Ni, Si, Sn, W, O, N, and H. (For preceding period see NP-8447.) (J.R.D.)

19324 NRL-5464

Naval Research Lab., Washington, D. C.
HEAT TREATMENT OF Mn–V–Mo AGE-HARDENING AUSTENITIC STEEL. N. C. Howells and E. A. Lange. Feb. 8, 1960. 10p. Project Nos. RR-007-01-43-5412 and NS-013-124.

The age-hardening characteristics of Mn–V–Mo austenitic steels were determined as a function of the temperature of the solution treatment. The optimum condition for developing the full age-hardening potential of an alloy is $\frac{1}{2}$ hour at 2100°F followed by a water quench. Subsequent aging treatments required for maximum-hardness levels

are: 1 hour at 1400°F, 6 hours at 1300°F, or 16 hours at 1200°F. An aging temperature between 1200 and 1300°F is optimum for controlling the balance between yield strength and ductility. The yield strength of metals in the fully-aged condition is directly proportional to Brinell hardness, at 80,000 to 150,000 psi for the compositions investigated. (auth)

19325 NYO-2804

Nuclear Materials and Equipment Corp., Apollo, Penna.
QUARTERLY PROGRESS REPORT [FOR] NOVEMBER 16, 1959 TO FEBRUARY 15, 1960. Changed from OFFICIAL USE ONLY. July 5, 1960. 26p. Contract AT(30-1)-2264. OTS.

A study to ascertain the feasibility of depositing such metals as Nb, Si, Mo, V, and Cr on U and UO_2 spheres is reported. A horizontal vibrator reactor was investigated which is capable of coating approximately 1 pound of UO_2 spheres, 100 to 140 mesh, with 8 to 10 microns of Nb in 24 hours of continuous operation. Detailed physical characteristics of these spheres were not determined. Chromium was applied to UO_2 pellets over a 0.5 micron Ni undercoating resulting in uniform, nonporous, adherent chromium coatings 6 to 8 microns thick. Equally successful chromium coatings were applied over Nb undercoats on UO_2 spheres. In other investigations, it was found that a process involving the reduction of chromic chloride was successful in depositing chromium on UO_2 spheres in high purity, dense non-porous deposits. Alternate processes under evaluation include vapor plating tungsten and molybdenum, hydrogen reduction of niobium and vanadium chlorides, and electrolytic coating of UO_2 and U. (J.R.D.)

19326 NYO-9076

General Electric Co. Electronics Lab., Syracuse, N. Y. and General Electric Co. Missile and Space Vehicle Dept., Philadelphia.

HIGH ENERGY STORAGE CERAMIC CAPACITOR. Final Report. J. M. Blank, H. C. Craig, H. W. Gandy, D. A. Lupfer, C. E. McCain, H. S. Moore, L. T. Piekarski, F. G. Reeny, J. W. Roy, V. A. Russell, P. D. S. St. Pierre, and W. Tantraporn—Philipp H. Klein, ed. Feb. 29, 1960. 97p. Contract AT(30-1)-1963. (R60ELS-450-9). OTS.

A solid solution containing 35% $SrTiO_3$ and 65% $BaTiO_3$ was formed into ceramic disks with densities as high as 99% of the theoretical value. Contouring of the surfaces of the capacitors to prevent edge breakdown was accomplished by ultrasonic and diamond-wheel grinding. Application of electrodes by evaporation of metallic silver proved satisfactory for most of the testing. The highest measured dielectric strengths were slightly in excess of 400 v/mil for one-inch capacitors and 200 v/mil for five-inch disks. In high-density ceramic bodies, the importance of dielectric breakdown in microscopic pores of the medium was found to be subordinate to breakdown by means of excessive conduction through the grain boundaries. (auth)

19327 ORNL-2387 (Pts. 1-5) (Del.)

Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1957. Feb. 19, 1958. Decl. with deletions Oct. 28, 1959. 281p. Contract W-7405-eng-26. OTS.

Progress is reported on reactor and facility construction, component development and testing, instrument and controls development, engineering design studies, design physics, materials and components inspection, heat transfer studies, phase equilibrium studies, chemical reactions in molten salts, physical properties of molten materials,

production of purified mixtures, analytical chemistry, development studies of Ni-Mo alloys and Inconel, welding and brazing, corrosion and mass transfer, materials fabrication, metallographic examinations of Engineering Test components after service, nondestructive testing, and radiation damage. (W.L.H.)

19328 RFP-191

Dow Chemical Co. Rocky Flats Plant, Denver.
INVESTIGATION OF SALTS FOR USE IN URANIUM METAL HEAT-TREATING BATHS. S. R. Pocsik.
July 25, 1960. 21p. Contract AT(29-1)-1106. OTS.

Numerous salts were considered for uranium metal annealing baths. Tests on melting point, solubility, corrosion stability, and hydrogen concentration were conducted on the salts which appeared to be the most feasible for this operation under existing conditions. (auth)

19329 SCNC-309

Sylvania-Corning Nuclear Corp., Bayside, N. Y.
QUARTERLY TECHNICAL PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1960. May 1960. 42p. Contract AT-30-1-GEN-366. OTS.

Research was continued on the fabrication of low-cost, high-quality ceramic, rod-type fuel elements. Hot isostatic pressing techniques are used in this fabrication process. Work was continued to improve the thermal conductivity of UO_2 pellets by the addition of small amounts of other oxides. Determinations were made of the behavior of stainless steel-clad, isostatically pressed UO_2 samples relative to standard pellitized UO_2 , under prolonged neutron irradiation. Characteristics and dimensional stability of two uranium-yttrium alloys were determined for neutron irradiation at high temperatures. (For preceding period see SCNC-306.) (B.O.G.)

19330 SUDAER-80

Stanford Univ., Calif.
A SURVEY OF THE THEORIES OF CREEP BUCKLING. N. J. Hoff. June 1958. 66p. Contract AF49(638)-223. (AFOSR-TN-60-382).

A survey is presented of the theories of buckling of structural elements whose material is subject to creep deformations. Two fundamentally different approaches to the solution of the buckling problem are discussed. In one, the structural element is assumed to be perfect and perfectly centered under the loads and buckling is initiated by a disturbance in the configuration. In the second, the creep deformations begin in consequence of the deviation of the unloaded centerline or median plane of the structural element from the line of load application. In both cases the element has a finite lifetime. A critical time of creep buckling is defined beyond which the element cannot be used to carry the prescribed loads. (auth)

19331 SUDAER-86

Stanford Univ., Calif.
THERMODYNAMIC FOUNDATIONS OF THE THEORY OF DEFORMATION. J. F. Besseling. Aug. 1959. 31p. Contract AF49(638)-223. (AFOSR-TN-59-871).

It is shown that a continuum theory of deformation can be founded on thermodynamic principles, the Galilean principle of relativity, and the concept of a natural reference state which at any instant is locally reproducible by a reversible process. The theory is a priori restricted to small inelastic strains. Explicit relations in terms of material properties are presented for small deviations from the natural reference state. Attention is drawn to the inherent nonlinearity of the thermoelastic equations in dynamic problems. (auth)

19332 TID-6084

Sylvania-Corning Nuclear Corp., Bayside, N. Y.
INFORMAL LETTER PROGRESS REPORT (FOR) MAY 1960. 10p. OTS.

A series of BaO and $BaO-ZrO_2$ doped UO_2 samples was pressed for sintering. The $BaO-UO_2$ compositions were sintered under argon for 3 and 14 hours. All of the samples had several fine cracks and showed very little densification. Thermal conductivity measurements were continued on 8 mole % $CaO-UO_2$ and mole % $Nb_2O_5-UO_2$ samples. In-pile thermal conductivity samples were examined after irradiation. The sample doped with 4 mole % Y_2O_3 showed 10% lower average thermal conductivity than the UO_2 control sample, instead of 30% greater as expected. Electrical resistivity measurements in a vacuum at elevated temperatures were made on undoped UO_2 samples in order to check the equipment. Trial thermal expansion measurements were made in air on alundum and copper and in a vacuum on a niobium alloy with the newly installed Gaertner Interferometer. Samples of UO_2 powder, consolidated by tamping the powder directly into the cladding and by sonic and ultrasonic vibrations, were hot isostatically pressed. Maximum density was obtained using the tamping method. A review of sample design was made with regard to internal pressures which may be generated by fission product gases. To preclude the possibility of cladding rupture, the samples were redesigned, internally, to accommodate a $1/4$ -in. high porous spacer plug at one end. Two samples of 100% fused UO_2 powder clad in niobium were hot isostatically pressed at 1415 and 1500°C for one hour at 7,500 psi. A significant densification was obtained. Thermanol cladding, received in as-cast condition, was hot rolled to refine the grain structure before being machined into tubes. (M.C.G.)

19333 WADC-TR-58-457(Pt. II)

Alloyd Corp., Cambridge, Mass.
RESEARCH ON TECHNIQUES FOR THE PRODUCTION OF ULTRA-PURE BERYLLIUM. Period covered: July 1, 1958 to June 30, 1959. Malcolm Basche and Laurence M. Schetky. Dec. 23, 1959. 54p. Project No. 7351. Contract AF33(616)-5300. OTS.

Techniques for making high-purity Be such as zone purification in moderate vacuum, distillation under high vacuum, and purification through halide reduction of $BeCl_2$ were investigated. Zone purification in vacuum proved to be impractical as a result of high Be vapor pressure. Distillation under high vacuum showed promise. Purification through halide reduction produced Be 99.6% and showed promise for improvement. (auth)

19334 WAPD-BT-18(p.1-12)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
APPLICATION OF STRESS-CONCENTRATION FACTORS. B. F. Langer. p.1-12 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

Recent developments in the field of notch-sensitivity and low-cycle fatigue made it possible to improve on some of the commonly-used rules for the application of stress-concentration factors in fatigue. In this article, methods are given for predicting the fatigue life of a member based on the theoretical stress-concentration factor, the properties of the material, and data obtained from strain-cycling fatigue tests. When these methods are used, the same strength-reduction factor can be used regardless of whether the expected number of cycles is large or small. For the case of fluctuating stress, the factor should be applied to both the steady and the alternating components,

and account should be taken of the shift in steady stress which is produced by plastic yielding. (auth)

19335 WAPD-ZH-23

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

ZIRCONIUM HIGHLIGHTS. Mar. 1960. 26p. Contract AT-11-1-GEN-14. OTS.

Investigations are reported on: the effects of the method of fabrication on the properties of Zircaloy-4; fatigue of welds in Zircaloy-2 fuel cells; effects of internal pressure on thin-wall Zircaloy-2 tubes, especially creep-rupture behavior and the effect of stress on ductility; and copper contamination in Zircaloy-2 and its removal by electrolytic means. (M.C.G.)

19336 WAPD-ZH-24

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

ZIRCONIUM HIGHLIGHTS. May 1960. 22p. Contract AT-11-1-GEN-14. OTS.

The effect of Fe and O₂ variation on corrosion and hydrogen uptake behavior of Zircaloy-4 is being studied. Because nitrogen-rich inclusions were found in Zircaloy-2 cover plate stock, attempts were made to generate nitrogen-rich inclusions in Zircaloy fabricated products. The corrosion behavior of Zircaloy-2 with various levels of Fe content was studied. An evaluation is presented of the powder produced from the electrolytic refining of Zircaloy machine scrap. (W.L.H.)

19337 WASH-199

Division of Research, AEC.

URANIUM ALLOY NEWSLETTER NO. 12.

Edward Epremian, ed. Oct. 1955. Decl. Mar. 30, 1960. 50p. OTS.

Argonne National Lab. Saturation experiments of high-purity U in graphite crucibles resulted in a preliminary liquidus curve of the C-U system. Preliminary tests of the attack of Pu-U alloys in Na at 450° were completed. Hardness, heat treatment, constitution diagrams, phase studies, and mechanical properties of U-Zr alloys were reported. A binary equilibrium phase diagram was constructed for U alloys containing 5 wt.% Nb. A study was made of the radiation effects, preparation, corrosion resistance, and extrusion of Si-U systems. The lower bounding surface of the single-phase gamma region was determined for U alloys containing up to 8 wt.% Zr and 5 wt.% Nb. Armour Research Foundation. Carbon-uranium systems were prepared by arc melting small 50 gram melts. Battelle Memorial Institute. An evaluation of heat-treatment and gaseous contamination effects upon microstructure, corrosion resistance, hardness, strength, and ductility of U-Zr alloys was made. An investigation of the phase relationship between the delta phases of the U-Zr and Ti-U alloys was continued. Hot hardness of U-Zr and Mo-U alloys is tabulated. The development of cast fuel elements, preparation and properties of low-melting Cr-U alloy, the behavior of Cr-U alloys during cycling between 300 and 1275°F, and the preparation of Al-U and U-Zr alloys are reported. Hanford Atomic Products Operation. A comparison was made of the tensile properties of certain U alloys to those of irradiated U. Mallinckrodt Chemical Works. A summary of the manufacture and machining of Si-U ingots is given. Nuclear Metals, Inc. A study is being made of the feasibility of the Si-U system as a material for stable clad fuel elements capable of surviving a defect in high-temperature water. A study was reported on U-Zr alloy extrusion constants, stabilizing treatments of Zr clad U-Zr alloy, and the diffusion

between a Zr-U core and Zircaloy-2 cladding. Sylvania Electric Products Inc. Techniques were worked out for the preparation of 2 wt.% Zr-U alloys by powder metallurgy, and the hardness and tensile properties of Mo-U alloys and 2 wt.% Zr-U alloys are reported. Dimensional changes as a result of thermal cycling powder metallurgy pin type U-Zr and Mo-U alloys and alloys for improved corrosion resistance were studied. Westinghouse Atomic Power Div. Duplex melted and extruded alloys of U-Nb were corrosion tested in 650°F water and Nb-Ti-U alloys were fabricated and corrosion tested in 650°F water. The influence of water additions on the corrosion of U-Mo alloys, the homogenization of unclad Mo-U alloys, phase studies, and hydrogen overvoltage were studied. Growth of restrained U under irradiation is tabulated. (For preceding newsletter see WASH-198.) (J.R.D.)

19338 AEC-tr-4125

APPLICATION OF RESULTS OF THE EQUILIBRIUM STUDY OF FURNACE ATMOSPHERES AND PROBLEMS OF BRIGHT ANNEALING AND ANNEALING WITHOUT DE-CARBURIZATION. (Anwendung der Ergebnisse der Gleichgewichtsforschung auf Ofenatmosphären und Fragen der entkohlungsfreien und Blankglühung). Gustav Neumann. Translated for Oak Ridge National Lab. from Arch. Eisenhüttenw. 14, 429-38(1941). 36p. (Includes original, 10p.). JCL.

Water gas diagram with the oxidation-reduction curves for Fe, Ni, W, Mo, Cr, and Mn is presented. A phase diagram of a protective gas for an annealing furnace is given. A water gas-methane diagram is given with plotted equilibrium curves of the iron-carbon structure and of free carbon. Transfer into the phase diagram of a protective gas in an annealing furnace and evaluation of carburizing or decarburizing problems are included. (tr-auth)

19339 AEC-tr-4132

NICKEL PLATING BY THERMAL DECOMPOSITION OF NICKEL CARBONYL VAPOR. A. M. Verbovskii and A. L. Rotinian. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Priklad. Khim. 33, 102-10(1960). 14p. JCL or LC.

The design and optimum techniques for nickel plating by thermal decomposition of nickel carbonyl vapor are described. Use of the method results in the production of qualitative, non-porous platings. The basic properties of platings obtained using this method were examined, and their anticorrosive properties were established. (J.R.D.)

19340 NP-tr-448

Akademiya Nauk S.S.S.R.

METALLURGY AND METALLOGRAPHY. PART 1. (A Translation of Excerpts from "Metallurgiya i Metallovedenie." A Publication of the Publishing House of the Academy of Sciences, U.S.S.R., Moscow, 1958). 558p. OTS.

Abstracts were prepared for 27 of 49 papers presented on diffusion of various elements in alloys and steel, tracer studies in metallurgy, and various properties of alloys. (C.J.G.)

19341 NP-tr-448(p.25-36)

TUNGSTEN DISTRIBUTION IN MOLTEN IRON. V. M. Zamoruev (Zamoruyev). p.25-36 of METALLURGY AND METALLOGRAPHY.

The distribution of tungsten in molten iron was investigated. A relationship between the conditional diffusion coefficient and temperature was found. An approximate solution for the diffusion coefficient in the convective-diffusion equation is given. It was found that the molecular-diffusion coefficient of tungsten in molten iron was of the order of

10^{-6} cm²/sec. A criterion for evaluating the quality of a ferroalloy from the mode of its distribution in molten iron is contained. (C.J.G.)

19342 NP-tr-448(p.47-59)

INVESTIGATION OF THE DISTRIBUTION OF ALLOYING ELEMENTS IN THE CRYSTALLIZATION OF STEEL. V. M. Tageev (Tageyev) and Yu. D. Smirnov. p.47-59 of METALLURGY AND METALLOGRAPHY.

The effects of admixtures of rare earths on alloying-element distribution during ingot crystallization and on improvement in the mechanical properties of steel were studied. It was found that the admixture of rare earths into deoxidized steel caused precipitation of the sulfide phase in the course of crystallization at an earlier stage than its precipitation in steel with no admixtures. It is concluded that alloying elements, which failed to form a dispersed phase in the molten metal, behave in the interior of a dendrite as do phosphorus and tungsten. Alloying elements which formed a dispersed phase at an early stage of crystallization were found to be distributed within the confines of a dendrite similar to the distribution of sulfur when rare earths were added. (C.J.G.)

19343 NP-tr-448(p.98-106)

DIFFUSION AND THERMODYNAMIC CHARACTERISTICS OF CERTAIN DILUTE SOLID SOLUTIONS. M. E. (Ye) Yanitskaya and A. A. Zhukhovitskii (Zhukhovitskiy). p.98-106 of METALLURGY AND METALLOGRAPHY.

The role of kinetic and thermodynamic factors in copper-silver and silver-tin alloys when the self-diffusion rate is changed by small amounts of admixtures in metals was evaluated. Self-diffusion parameters and thermodynamic characteristics (activity coefficients and partial heats of dilution) of the solvent were determined in a number of silver-based alloys. Admixtures were found to have a considerable effect on the diffusion mobility of the components of the alloy which in terms of the transition-state theory is explained by a drastic reduction in the height of the potential barrier which determines the activation energy. (C.J.G.)

19344 NP-tr-448(p.119-29)

A STUDY OF CARBON DIFFUSION IN ALLOYS USING THE RADIOACTIVE ISOTOPE C¹⁴. P. L. Gruzin, Yu. A. Polikarpov, G. B. Fedorov, and M. A. Shumilov. p.119-29 of METALLURGY AND METALLOGRAPHY.

A method for measuring the coefficient of carbon diffusion in alloys, taking into account the physico-chemical properties of carbon and the radiation from C¹⁴, was devised. Carbon diffusion in ferrite alloyed with Ni, Mo, Cr, Mn, and Si was investigated. The influence of Si and Ni admixtures on carbon diffusion in ferrite was studied. (C.J.G.)

19345 NP-tr-448(p.130-40)

AN INVESTIGATION OF COBALT DIFFUSION IN MULTI-COMPONENT ALLOYS OF THE FERRITE AND FERRITE-AUSTENITE TYPE. S. D. Gertsriken, I. Ya. Dekhtyar, L. M. Kumok, and E. G. Madatova. p.130-40 of METALLURGY AND METALLOGRAPHY.

Cobalt diffusion in ferrite and ferrite-austenite type multi-component alloys containing Cr, Ni, and Al with minor additions of Mo, Nb, Zr, and B was investigated at 800 to 1200°C by the absorption method. (C.J.G.)

19346 NP-tr-448(p.176-87)

A STUDY OF COBALT DIFFUSION IN NICKEL-MOLYBDENUM ALLOYS. S. D. Gertsriken, I. Ya. Dekhtyar, and V. S. Mikhalekov. p.176-87 of METALLURGY AND METALLOGRAPHY.

Cobalt diffusion parameters in 5 to 30 wt.% Mo-Ni al-

loys were investigated by the absorption method using Co⁶⁰ at 1050 to 1250°C. The activation energy of diffusion increased with an increase in molybdenum concentration; a maximum was reached at concentrations corresponding to maximal filling of vacant states in d electron shells and decreased thereafter. The temperature coefficient of the modulus of elasticity was found to be 7.6×10^{-4} degree⁻¹ (C.J.G.)

19347 NP-tr-448(p.196-209)

STUDY OF DIFFUSION IN ZIRCONIUM AND IN CERTAIN ALLOYS WITH A ZIRCONIUM BASE. E. (Ye.) V. Borisov, Yu. G. Godin, P. L. Gruzin, A. I. Evstyukhin (Yevstyukhin), and V. S. Emel'yanov (Yemel'yanov). p.196-209 of METALLURGY AND METALLOGRAPHY.

Coefficients of self-diffusion were determined in zirconium at 700 to 1200°C and in niobium-zirconium and tantalum-zirconium alloys at 900 to 1200°C. Coefficients of tantalum diffusion in zirconium were determined at 700 to 1200°C. Self-diffusion coefficients of zirconium and its alloys were determined at 300 to 1200°C. (C.J.G.)

19348 NP-tr-448(p.210-18)

AN INVESTIGATION OF IRON DIFFUSION IN ALLOYS OF THE IRON-CHROMIUM SYSTEM. A. Ya. Shinyayev (Shinyayev). p.210-18 of METALLURGY AND METALLOGRAPHY.

The diffusion coefficient, frequency factor, and activation energy of iron in chromium-iron alloys (Cr content of 21, 41.5, 51.7, 56.5, 61.5, and 81 at.%) were determined at 957, 1060, 1145, and 1250°C. (C.J.G.)

19349 NP-tr-448(p.236-47)

THE INFLUENCE OF ALLOYING ON THE STATE OF CARBON ATOMS IN ALLOYS. Yu. F. Babikova and P. L. Gruzin. p.236-47 of METALLURGY AND METALLOGRAPHY.

Carbon transference numbers were studied in iron, Fe-(2.5 and 5.9%) Cr alloys, Fe-(1 and 2%) Ni alloys, Fe-(1 and 2%) Mn alloys, Fe-(2 and 3%) Si systems, nickel, and Ni-(1 and 4%) Cr alloys at 500 to 900°C (temperature of electrolytic diffusion annealing). The degree of ionization of carbon atoms in the alloys is discussed. Data on the influence of alloying on electrolytic diffusion of carbon in alpha iron and in nickel are presented. (C.J.G.)

19350 NP-tr-448(p.248-55)

AN INVESTIGATION OF DIFFUSION OF IRON OXIDES IN BASIC REFRACTORIES. E. A. Prokof'eva (Ye. A. Prokof'yeva) and V. V. Goncharov. p.248-55 of METALLURGY AND METALLOGRAPHY.

The diffusion coefficients of iron oxides in magnesite, chromite, and magnesite-chromite were determined at 1500, 1600, and 1700°C. The diffusion coefficients were in general directly proportional to porosity, increasing with increase in pore size. (C.J.G.)

19351 NP-tr-448(p.256-64)

AN INVESTIGATION OF THE DIFFUSION PROCESSES OF IRON AND CHROMIUM IN THE OXIDES α -Al₂O₃, α -Cr₂O₃, NiCr₂O₄ AND NiAl₂O₄. D. V. Ignatov, I. N. Belokurova, and I. N. Belyanin. p.256-64 of METALLURGY AND METALLOGRAPHY.

Diffusion coefficients, activation energies, and frequency factors of iron and chromium were determined in α -Al₂O₃, α -Cr₂O₃, NiCr₂O₄, and NiAl₂O₄ at 900 to 1200°C. (C.J.G.)

19352 NP-tr-448(p.278-84)

THE USE OF ISOTOPES IN THE STUDY OF ATOMIC MOBILITY AND INTERATOMIC INTERACTION IN METALS. E. (Ye.) Z. Vintaykin, P. L. Gruzin, and S. N. Fedorov. p.278-84 of METALLURGY AND METALLOGRAPHY.

A mass spectrometric method for the determination of heats of sublimation of metals is described. The heats of sublimation of cadmium, silver, and zinc were determined to be 26.5, 68, and 30.1, respectively. (C.J.G.)

19353 NP-tr-448(p.304-15)

THE INFLUENCE OF ALUMINUM ON THE TENDENCY OF STEEL TO PRODUCE A STONE-LIKE FRACTURE. A. M. Polyakova, L. V. Smirnov, and V. D. Sadovskii (Sadovskiy). p.304-15 of METALLURGY AND METALLOGRAPHY.

The influence of aluminum on sulfide distribution in steel and on the tendency of steel to produce stone-like fracture was investigated. The tendency of steel to produce a stone-like fracture increased with an increase in aluminum content up to 0.155%. The stone-like fracture was found to be produced when the sulfides precipitate along the grain boundaries of the austenite, which exists at the temperature of superheating. (C.J.G.)

19354 NP-tr-448(p.316-30)

INVESTIGATION BY RADIOGRAPHY OF CARBON DISTRIBUTION IN FERROALLOYS. A. S. Zav'yalov and B. I. Bruk. p.316-30 of METALLURGY AND METALLOGRAPHY.

The distribution of small quantities of carbon in ferroalloys during heat treatment which contain Cr, Ni, Mn, Si, and Mo was investigated by autoradiography. In alloys whose concentration of alloying elements and carbon did not exceed their solubility limit in iron at a given temperature, it was found that carbon is distributed relatively uniformly in the grain body as a result of sudden cooling from a temperature above 900°C. High tempering of alloys containing non-carbide-forming elements in quantities exceeding their solubility limit in iron resulted in a carbon enrichment of grain boundaries. High tempering of alloys containing carbide-forming elements in quantities not exceeding the limit of solubility in iron resulted in a sharp retarding of carbon redistribution to grain boundaries. Carbon was found to diffuse into the precipitation zone of alloys containing carbide-forming elements in quantities exceeding their solubility limit in iron during the process of high tempering. (C.J.G.)

19355 NP-tr-448(p.348-61)

CALCULATION OF THE NUMBER OF β EMITTERS REQUIRED FOR RADIOGRAPHY AND RADIOMETRIC INVESTIGATIONS. L. M. Efimov (Yefimov). p.348-61 of METALLURGY AND METALLOGRAPHY.

A theoretical calculation of the electron yield from a sample was made, and on this basis the problem of the necessary concentration of β tracers for radiometric analysis and radiography was solved. The required exposure time in radiography was calculated. (C.J.G.)

19356 NP-tr-448(p.374-86)

INVESTIGATION OF CHROMIUM DISTRIBUTION IN STAINLESS STEEL DURING ARC WELDING. B. I. Bruk. p.374-86 of METALLURGY AND METALLOGRAPHY.

The distribution of chromium in stainless steel during arc welding was studied using Cr^{51} as a tracer. The requisite chromium concentration in seam metal and coating for different nickel contents (8 to 11%) in a weld were determined. (C.J.G.)

19357 NP-tr-448(p.387-92)

QUANTITATIVE EVALUATION OF DENDRITIC SEGREGATION IN STEEL THROUGH AUTORADIOGRAPHY WITHOUT THE USE OF STANDARDS. M. F. Longinov. p.387-92 of METALLURGY AND METALLOGRAPHY.

A method is described for the quantitative evaluation of a chemical inhomogeneity of an alloy by autoradiography. The method was used for quantitative evaluation of the dendritic segregation of sulfur and tungsten in steels. (C.J.G.)

19358 NP-tr-448(p.393-409)

APPLICATION OF A QUANTITATIVE AUTORADIOGRAPHY METHOD TO THE INVESTIGATION OF MICROINHOMOGENEITY OF MAGNESIUM ALLOYS. Z. A. Svider-skaya, M. E. Drits, and E. S. Kadaner. p.393-409 of METALLURGY AND METALLOGRAPHY.

The intracrystalline inhomogeneity in the structure of calcium-magnesium alloys was investigated by radioautographic techniques employing Ca^{45} . A correlation between the change of microinhomogeneity with the change in the cooling rate of the alloy was investigated. Intradendritic microinhomogeneity in the Al-Ca-Mg-Mn system was studied. (C.J.G.)

19359 NP-tr-448(p.410-21)

CONCERNING THE POSSIBILITY OF AUTORADIOGRAPHIC DETECTION OF NONUNIFORMITIES IN CONCENTRATIONS OF ADSORPTIVE ORIGIN. V. I. Arkharov, V. S. Galishev, S. M. Klotzman, and A. N. Timofeev (Timofeyev). p.410-21 of METALLURGY AND METALLOGRAPHY.

A calculation of β -radiation distribution at the surface of a sample was made with allowance for absorption caused by multiple scattering. The results are discussed relative to application in the radioautographic detection of nonuniformities arising from internal adsorption in alloy systems. The experimental conditions necessary for detection of such nonuniformities of concentration are discussed. (C.J.G.)

19360 NP-tr-448(p.436-49)

INVESTIGATION OF MIXING AND DIFFUSIONAL PROCESSES IN WELDED JOINTS OF TWO-LAYER ROLLED STEEL. E. M. Kuzmak and N. P. Karmazinov. p.436-49 of METALLURGY AND METALLOGRAPHY.

The influence of the thermal cycle on mixing and diffusional processes in welded joints of two-ply rolled steel was investigated. A pattern of carbon rediffusion was established in the zones adjacent to the fusion line. The process of mixing of dissimilar steels was investigated to determine the degree of seam-metal homogeneity during automatic welding. (C.J.G.)

19361 NP-tr-448(p.450-8)

INFLUENCE OF FAST-NEUTRON IRRADIATION ON RECOMBINATION OF ELECTRONS AND HOLES IN GERMANIUM CRYSTALS. V. S. Vavilov, A. V. Spitsyn, L. S. Smirnov, and M. V. Chukichev. p.450-8 of METALLURGY AND METALLOGRAPHY.

The effect of crystal lattice defects formed by fast neutrons on electron and hole recombination in germanium crystals was studied. With a surface recombination rate of 150 cm/sec, the effective cross section of hole capture by defects was determined to be $1.05 \times 10^{-15} \text{ cm}^2$ and $1.3 \times 10^{-15} \text{ cm}^2$ at 600 cm/sec. (C.J.G.)

19362 NP-tr-448(p.459-69)

INVESTIGATION OF THE Ni_3Fe SUPERLATTICE BY THE NEUTRON DIFFRACTION METHOD. B. G. Lyashchenko, D. F. Litvin, I. M. Puzey, and Yu. G. Abov. p.459-69 of METALLURGY AND METALLOGRAPHY.

Neutron-diffraction studies were performed on iron-nickel solid solutions to determine if the ordering energy was basically ferromagnetic in nature. The studies were confined mainly to the Ni_3Fe superlattice. (C.J.G.)

19363 NP-tr-448(p.470-83)

THE EFFECT OF NEUTRON IRRADIATION ON THE MARTENSITIC TRANSFORMATION. O. P. Maksimova and A. I. Zakharov. p.470-83 of METALLURGY AND METALLOGRAPHY.

The effects of neutron irradiation on the martensitic transformation in steels alloyed with carbon, nickel, man-

ganese, and copper were studied. In steels, regardless of carbon content or character of alloying element, it was found that preliminary neutron irradiation increases the extent of the martensitic transformation which takes place during subsequent cooling to low temperatures. (C.J.G.)

19364 NP-tr-448(p.489-98)

EXPERIMENT ON THE USE OF TRITIUM FOR THE DETERMINATION OF HYDROGEN IN METALS. A. I. Chizhikov and V. K. Boyarshinov. p.489-98 of METALLURGY AND METALLOGRAPHY.

Methods of employing tritium for the determination of hydrogen in metals by means of isotope exchange are reviewed. (C.J.G.)

19365 NP-tr-448(p.511-23)

THE USE OF RADIOACTIVE ISOTOPES FOR THE PRODUCTION AND INVESTIGATION OF SELENIUM RECTIFYING ELEMENTS. N. V. Yur'ev (Yur'yev). p.511-23 of METALLURGY AND METALLOGRAPHY.

The use of radioisotopes for monitoring the production of selenium rectifying elements is discussed. Specific applications of employing radioisotopes to investigate conditions of cadmium sulfide formation, the effects of the addition of bromine to selenium, and to measure the cadmium selenide layer are discussed. (C.J.G.)

19366 NP-tr-448(p.535-44)

APPLICATION OF TRITIUM TO WELDING AND RADIOGRAPHY WITH TRITIUM. B. I. Bruk and G. I. Nikolaev. p.535-44 of METALLURGY AND METALLOGRAPHY.

The application of tritium to show the effect of free moisture, contained in the coating of electrodes, on the saturation of the seam metal and adjacent primary metal with hydrogen during arc welding is described. It was found that the free moisture of the electrode coating plays an active part in saturating the seam metal with hydrogen during welding. The application of tritium in studying the distribution of hydrogen in titanium and zirconium radiographically is discussed. (C.J.G.)

19367 NP-tr-448(p.545-51)

THE USE OF SCINTILLATION APPARATUS FOR MEASURING THE RADIATION OF TWO-COMPONENT GAMMA-RADIOACTIVE ALLOYS (Fe^{59} , Cr^{51}). N. P. Ivanchev and L. I. Ivanov. p.545-51 of METALLURGY AND METALLOGRAPHY.

A description of a scintillation apparatus for simultaneous measurement of the gamma-radiation of chromium-iron alloys is given. A method, employing the scintillation apparatus, is described for determining the simultaneous evaporation rate of chromium and iron in chromium-iron alloys. From the results the heat of sublimation was calculated. (C.J.G.)

19368

PERSPECTIVES IN APPLICATION OF RADIOACTIVE ISOTOPES AND NUCLEAR EMISSIONS IN METALLURGY AND OTHER TECHNOLOGICAL STUDIES. A. M. Samarin and N. S. Fomichev. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo*, No. 6, 121-6(1959) Nov.-Dec. (In Russian)

A review is presented on perspectives and various applications of radioactive isotopes and nuclear emissions in metallurgy, prospecting, material control, and other technological tests and applications. (R.V.J.)

Corrosion

19369 AERE-M-621

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. PART X. HYDROGEN ABSORPTION DURING OXIDATION IN STEAM AND AQUEOUS SOLUTIONS. B. Cox, M. J. Davies, and A. D. Dent. Apr. 1960. 19p. BIS.

Hydrogen generated by corrosion in steam or aqueous solutions is known to enter the corroding metal. In order to increase the amount of data available, hydrogen analyses were obtained on samples of zirconium alloys which were used in the H.A.R. corrosion program and on all specimens being used for a current study of the oxidation kinetics in steam. These data cast some light on the effects of time, temperature and alloying additions on the percentage of the hydrogen theoretically available from corrosion which is acquired by the underlying metal. (auth)

19370 ANL-6149

Argonne National Lab., Ill.

CHARACTERISTICS OF ANODIC AND CORROSION FILMS ON ZIRCONIUM. R. D. Misch. May 1960. 25p. Contract W-31-109-eng-38. OTS.

Zirconium anodizes similarly to tungsten in respect to the change of interference colors with applied voltage. However, the oxide layer on tungsten cannot reach as great a thickness. Hafnium does not anodize in the same way as zirconium but is similar to tantalum. By measuring the interference color and capacitative thicknesses on zirconium (Grades I and III) and a 2.5 wt.% tin alloy, the film was found to grow less rapidly in terms of capacitance than in terms of interference colors. This was interpreted to mean that cracks develop in the oxide as it thickens. The effect was most pronounced on Grade III zirconium and least pronounced on the tin alloy. The reduction in capacitative thickness was especially noticeable when white oxide appeared. Comparative measurements on Grade I zirconium and 2.5 wt.% tin alloy indicated that the thickness of the oxide film on the tin alloy (after 16 hours in water) increased more rapidly with temperature than the film on zirconium. Tin is believed to act in ways to counteract the tendency of the oxide to form cracks, and to produce vacancies which promote ionic diffusion. (auth)

19371 CEA-1193

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

ALLIAGES D'ALUMINIUM CONTENANT DU FER ET DU NICKEL. INFLUENCE DE LA STRUCTURE ET DE LA TENUEUR SUR LA RESISTANCE À LA CORROSION PAR L'EAU À HAUTE TEMPERATURE. (Aluminum Alloy Containing Iron and Nickel. Influence of Structure and Composition on the Corrosion Behavior in High Temperature Water). H. Coriou, L. Grall, J. Hure, and A. Roux. 1959. 44p.

The corrosion structure was determined for a series of Al base alloys having an Fe + Ni content below 3%. The tests ran 5,000 hours in an autoclave at 350°C in demineralized water. For contents greater than 0.5% of Fe and Ni, the most important factor is the structure and distribution of intermetallic compounds in the separated phase. The particles should be as fine and as uniformly distributed as possible. The corrosion products formed at the surface subdivide into three distinct layers the total thickness of which tends rapidly toward limit and stabilizes. (tr-auth)

19372 CF-59-4-107

Oak Ridge National Lab., Tenn.

THE REMOVAL OF CORROSION SCALE FROM HEAT EXCHANGER BY CHEMICAL TREATMENTS. Oscar Menis. Apr. 15, 1959. 5p. OTS.

A study was made to select a suitable solvent for disintegrating a corrosion scale from stainless steel systems

without attacking the stainless steel. In this investigation a particular sample of stainless steel corrosion scale appeared to be disintegrated most effectively in a solution of the trisodium salt of N-hydroxyethylethylenediaminetriacetic acid (Versenol) and ammonium acetate. In a subsequent test with this solution in a REED dynamic loop a considerable disintegration of scale from the loop was observed. In this test after a period of approximately 60 hours, the iron content in the solution was found to be 10 g per liter; thus indicating that the mixture of Versenol and ammonium acetate can be used to disintegrate partially the corrosion scale from a stainless steel system. (auth)

19373 CF-60-5-137

Oak Ridge National Lab., Tenn.

EXAMINATION OF CORROSION SPECIMENS FROM SLURRY BLANKET MOCKUP RUNS SM-6 THROUGH SM-9. R. B. Gallaher, S. A. Reed, and G. G. Warner. May 26, 1960. 12p. Contract [W-7405-eng-26]. OTS.

Low attack rates (0.1 to 0.5 mpy) were displayed by coupon specimens of type 347 stainless steel, titanium RC-55, and Zircaloy-2 which were exposed for 2877.5 hr in an oxygenated slurry of Th-8% U oxide, 116.5 hr in water, 6.9 hr in 5% HNO_3 , and 4.3 hr in 3% trisodium phosphate during runs SM-6 through SM-9 in the slurry blanket mockup. The leading coupon of type 347 stainless steel showed a slightly higher rate than the other stainless steel coupons due to entrance effects. Specimens of SA-212-B carbon steel displayed average attack rates of 2.9 mpy. (auth)

19374 LMSD-288232

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

HIGH-TEMPERATURE CORROSION OF BERYLLIUM IN AIR. Period covered: January 1 to December 31, 1959. W. Bradshaw and E. S. Wright. Jan. 1960. 44p. Contract NORD-17017.

This paper was originally printed under the same title in Vol. II, "Metallurgy and Chemistry," of General Research in Materials and Propulsion, January 1959—January 1960, LMSD-288140.

The corrosion of Be in air at 930 to 1295°C and in pure N at 980 to 1079°C was investigated. Experimental results indicated that the corrosion of Be in air follows a linear rate and is temperature-dependent with an activation energy of 1.1×10^5 cal/mole in the range 930 to 1065°C and 1.06×10^4 cal/mole in the range 1065 to 1295°C. The reaction rate was unaffected by pressures varying from 660 to 760 Torr, but may be affected by O/N ratios. (auth)

19375 NP-8845

Allied Chemical Corp. General Chemical Div., New York. CORROSION OF METALS AND ALLOYS BY FLUORINE. Final Report. R. B. Jackson. Mar. 1960. 75p. Contract AF04(611)-3389.

The corrosion of twenty-five metals and alloys by liquid and gaseous fluorine was studied. The liquid corrosion tests were performed at -320°F and exposure ranged from 5 hours to 3 days. Exposures to gaseous fluorine were made at approximately 80, 400, 700, and 1000°F . Exposure times were generally 5, 24, and 120 hours. Several specimens were also exposed to gaseous fluorine at elevated pressures and temperatures for 24 hours. Selected specimens were sectioned and photomicrographs taken to study the passivating fluoride film. Results of the five-hour tests indicate that all tested materials, except tantalum, may be exposed to fluorine at temperatures up to 400°F without exceeding a corrosion rate of one-half thousandth of an inch (0.0005") per hour. This arbitrarily chosen rate is not

intended to signify acceptability. It is equivalent to 4.4 inches per year, which is an extremely high corrosion rate under normal circumstances, but not excessive when exposure for only a few hours is required. Tests indicate that extrapolation of the results obtained from very short exposures to long time service, such as a year, is not reliable. In general, the corrosion rates tend to decrease as the exposure period is increased. Tests of materials at elevated pressures indicate that corrosion rates are generally higher than specimens exposed to the same temperatures at atmospheric pressure. Microscopic examination of selected specimens shows that materials such as monel and nickel form a relatively uniform passivating film at elevated temperatures. Aluminum 1100, however, shows indication of deep, non-uniform penetration. These and other materials are fully discussed. (auth)

19376 IGRL-T/C-109

CORROSION EVALUATION TESTS OF: I. AUSTENITIC STAINLESS STEEL. II. WELDED AUSTENITIC STAINLESS STEEL. A. P. Krijff and A. De Visser. Translated by R. G. Evan (U.K.A.E.A., Risley) from Smit Mededel. 9, 38-49, 79-87(1954). 30p.

The laboratory methods of corrosion testing of austenitic stainless steels are reviewed, and the advantages of the boiling nitric acid metallurgical test are outlined. The results of laboratory tests on different types of stainless-steel-plate material are discussed. A survey on the method of corrosion testing of welded austenitic stainless steel is presented. The influence of plate material properties on the test results is outlined, as well as the influence of plate thickness. (auth)

19377

ON THE CORROSION OF ALUMINIUM IN REACTOR. I. SIMPLE IN-PILE CORROSION TEST LOOP. Sueo Nomura (Japan Atomic Energy Research Lab., Tokyo). J. Atomic Energy Soc. Japan 2, 337-42(1960) June. (In Japanese)

For the purpose of obtaining information on the corrosion behavior of aluminum in aqueous systems under pile irradiation as well as on the techniques of in-pile loop experiments, a simple in-pile corrosion test loop was designed and placed in No. 9 beam hole at JRR-1 reactor under conditions similar to those that will be encountered by the fuel cladding in JRR-3 reactor: temperature, room temp up to 100°C ; flow rate, max 3 m/sec; and thermal neutron flux, max ca 3×10^{11} n/cm²·sec. The main part of this loop was made of 18-8 stainless steel (AISI type 304) with the aluminum test specimens placed at various positions in the test section within the reactor. Neutron flux distribution was measured from induced activities in test specimens placed in the loop. (auth)

19378

HYDROGEN PICKUP IN VARIOUS ZIRCONIUM ALLOYS DURING CORROSION EXPOSURE IN HIGH-TEMPERATURE WATER AND STEAM. Stanley Kass (Westinghouse Electric Corp., Pittsburgh). J. Electrochem. Soc. 107, 594-7 (1960) July.

The hydrogen pickup during corrosion in high-temperature water and steam of various binary and ternary alloys of zirconium with iron and tin was studied. The total hydrogen content of specimens exposed to 400°C steam was found to be greater than that of specimens exposed to 360°C water. Furthermore, the per cent of theoretical hydrogen absorbed in the various alloys was markedly affected by the binary or ternary alloy addition. The per cent theoretical hydrogen absorbed by binary zirconium-iron alloys increased as the iron content was increased from 0.3 to 1.5 wt. % and the value for

zirconium-tin alloys increased slightly as tin was increased from 0.5 to 0.9 wt. %. The hydrogen pickup behavior of ternary zirconium-tin-iron alloys reflected the behavior of zirconium-iron binary alloys. (auth)

19379

ON THE ANODIC OXIDATION OF COLUMBIUM. Robert Bakish (Alloyd Corp., Cambridge, Mass.). *J. Electrochem. Soc.* **107**, 653-4(1960) July.

The anodic oxidation behavior of niobium was studied by determining the voltage-current characteristics of niobium at 300 volts in a 0.1% H_3PO_4 solution from 1 to 80°C. The current rapidly decays to the leakage current level and thereafter remains constant up to a certain time, after which it increases abruptly and goes out of range. The time to current reversal is inversely dependent on temperature and voltage, and is said to be a consequence of the crystallization of the amorphous oxide film. The effects of the voltage on the oxide topography is shown. It is concluded that niobium shows both similarities and differences with tantalum. (D.L.C.)

19380

CORROSION PROTECTION FOR NITRIDED STAINLESS STEELS IN WATER. L. Ya. Gurvich and A. G. Andreeva. *Metalloved. i Termicheskaya Obrabotka Metal.* No. 1, 10-13(1960) Jan. (In Russian)

The corrosion resistance of nitrided stainless steels in water depends on the chemical composition of the steel and on the temperature and degree of dissociation of the ammonia in which nitriding was done. In all cases there is a variation of degree of corrosion resistance with depth below the nitrided surface. There are four regions of corrosion resistance: the surface, having lowered resistance and a lowered negative electrode potential; a layer of high corrosion resistance having high electrode potentials; a corrosively unstable layer with lowered electrode potentials; and a core region having high corrosion resistance and high electrode potentials. The thickness of the unstable layer and its depth below the surface varies but is always in the range where polishing, machining, or water may expose it and lead to rapid corrosion in water. Several corrosion inhibitors were tested on nitrided samples of 25Cr18-N8V2 steel with the surfaces polished down to the unstable layer. The best results were obtained with samples treated for one hour in boiling 10% $K_2Cr_2O_7$ solution. After six months no corrosion had appeared on the surface of the samples. In addition, a supplementary treatment in a silicon bearing organic liquid, GKZh-94, after treatment in a 10% solution of $K_2Cr_2O_7$ at 70°C, further increased corrosion resistance. The corrosion of the GKZh-94 treated samples in water, after exposure to kerosene at 250°C and to gasoline at room temperature, was also shown to be significantly inhibited. (TTT)

19381

INTERGRANULAR CORROSION OF 1X18H9T STEEL IN STEAM-WATER MEDIUM. V. V. Gerasimov and K. A. Popova. *Metalloved. i Termicheskaya Obrabotka Metal.* No. 1, 13-15(1960) Jan. (In Russian)

The corrosive behavior of 3 alloys of this stainless steel system was investigated by exposing the specimens to distilled water and to 0.001 M H_2O_2 solution at 350°C and 170 kg/cm² for 1000 hrs and to steam at 550°C and 200 kg/cm² in autoclaves, changing the solution every 120 hr. H_2O_2 was chosen because it is formed in a number of energy-generating applications where such steels might be used. The specimens became coated with an oxide film after the test. Corrosive effects were not observed on specimens containing 0.08% C and 0.7% Ti while the other two alloys

containing less Ti and more C showed evidence of intergranular attack upon metallographic inspection. This confirms previous conclusions that this type of steel is subject to attack only in aggressive media. It is assumed that the Cr-poor grain boundaries are passivated when certain critical experimental parameters are reached. The specimens were tested in their original austenitic structure and after 2-hour annealings at 650°C. *Abstractor's note:* The code number refers to 18 Cr-9 Ni steel but it seemed awkward to transliterate the Russian letters to 1 Kh 18 N 9 T (referring to the Russian names of Cr-Ni-Ti). (TTT)

19382

EFFECT OF MOLTEN NITRATE-NITRITE MIXTURE AND OF ITS COMPONENTS ON MOLYBDENUM, TUNGSTEN, ZIRCONIUM, TANTALUM, AND NIOBIUM. E. I. Gurovich and G. P. Shtokman. *Zhur. Priklad. Khim.* **32**, 2673-7(1959) Dec. (In Russian)

It was shown previously that the corrosive behavior of steel in molten salt mixtures is strongly dependent on the presence of certain additives. Steels with Nb or V addition were more or less resistant against KNO_3 - $NaNO_2$ - $NaNO_3$ melts only up to about 500°C, while steels containing Mo and W offered considerably reduced resistance toward the molten salt mixture. Zirconium, Ta, and Nb in that order had the greatest beneficial effect on the corrosion resistance. It is suggested that steels containing Mo and W should not be used in applications in which they might be exposed to the effect of the nitrate-nitrite mixtures at elevated temperatures. The other metals may be used as alloying additives under these conditions. The tests were performed in quartz containers. (TTT)

Fabrication

19383 AD-231924

Chromalloy Corp., White Plains, N. Y.
EXPLOSIVE FORMING OF REFRACTORY METALS. Bi-Monthly Report No. 2 [for] August 31, 1959 through October 31, 1959. Richard L. Wachtell. Sept. 1, 1959. 50p. Contract NOas 59-6265-c.

Dies and firing fixtures were completed and put into use. Detonations were carried out using pure molybdenum, 1/2% Ti-moly alloy, and 17-7PH stainless steel. Three different explosives were used, with two transmission mediums and two temperatures. The results indicated that molybdenum and 1/2% Ti-moly alloy do not form satisfactorily at ambient temperature under the conditions used. However, at 200 to 212°F substantial elongation and plastic deformation occurred and much better forming was achieved. Tensile strength, yield strength, and elongation measurements made on the first lot of Universal Cyclops 1/2% Ti-moly are presented. (auth)

19384 HW-64294

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DEVELOPMENT OF A WELDING PROCESS FOR SPIRE-CAN FUEL ELEMENTS. G. R. Hanson. Mar. 11, 1960. 9p. Contract AT(45-1)-1350. OTS.

A welding method is described which was developed for use in spire-can fuel element fabrication. The method involves striking the welding arc on a block of copper, transferring to the outer weld position, then to the inner weld without interrupting the arc, and at the same time providing appropriate current programming. Equipment and procedure are discussed. (J.R.D.)

19385 HW-64335

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

UNIQUE FABRICATION PROCESSES APPLIED TO FUEL CLADDING MATERIALS. S. H. Bush. Mar. 15, 1960. 23p. Contract W-31-109-Eng-52. OTS.

A number of specialized fabrication techniques have been developed in the fuel element field because material costs, close tolerances, and severe limitations imposed by reactor environment often eliminated conventional fabrication processes. In some instances the operations pertained to the cladding alone, in others to the clad fuel. Specific fabrication processes discussed are: controlled plug and die sizing with metal and plastic dies; forming of internal and external ribs on tubes by swaging; controlled sinking and tapering by swaging; deep forming of fuel element hardware; vacuum precision casting of various types of fuel element hardware such as end caps and supports; special closure methods including swaging, extrusion closure utilizing the Dynapak, electron beam welding, and seam welding; attachment of supports by resistance spot and ultrasonic welding; and precision forming of irregular shapes by spark machining. (M.C.G.)

19386 NMI-9605

Nuclear Metals, Inc., Concord, Mass.

SECOND QUARTERLY REPORT TO WRIGHT AIR DEVELOPMENT DIVISION DEVELOPMENT OF RANDOMLY ORIENTED WROUGHT BERYLLIUM SHEET. F. M. Yans, A. K. Wolff, and A. R. Kaufmann. May 16, 1960. 28p. Contract AF33(616)-6616.

A summary of data is presented from rolling experiments in which the effects of reduction ratio and annealing heat treatments on the structure and orientation of cold-worked beryllium sheet were studied. Texture analysis experiments are also described in which the original and modified Schulz methods of texture analysis are examined, and studies to determine the relative importance of variables in the rolling process as they affect the structure and orientation of Be sheet are reported. Preliminary conclusions are included. (For preceding period see NMI-9602.) (J.R.D.)

19387 NOR-60-192

Norair. Div. of Northrop Corp., Hawthorne, Calif.

PROGRAM FOR THE DEVELOPMENT OF EXTRUDED BERYLLIUM SHAPES. Interim Engineering Report No. 8 [for] March 1, 1960 through May 31, 1960. 19p. Contract AF33(600)-36931.

The feasibility of unclad Be extrusion was demonstrated by the production of various extruded shapes up to 26-ft long with few defects. However, additional work is needed to perfect extrusion methods since consistency is still poor. (D.L.C.)

19388 NP-8797

Beryllium Corp., Reading, Penna.

BERYLLIUM CASTING—PHASE II. Interim Technical Report No. 6 [for] December 19, 1959—March 18, 1960. Paul M. Cohen and R. C. Harris. 29p. Contract AF33(600)-37902.

An evaluation was completed on the effect of pouring temperature and mold temperature on Be grain size. The results show a typical relationship of mold temperature and grain size with higher mold temperatures producing larger columnar grain diameters. Higher pouring temperatures produced smaller as-cast columnar grain diameters. No explanation is offered for this result. Small additions of Ge, La, and Zr were utilized as potential grain

refining additions. Some columnar grain size reduction was accomplished but optimum amounts were not determined. (For preceding period see NP-8552.) (auth)

19389 SSC-105

Swarthmore Coll., Penna.

WELD FLAW EVALUATION. Final Report. Samuel T. Carpenter and Roy F. Linsenmeyer. July 29, 1958. 120p. Project No. SR-126. Contract NObS-72060. (PB-161322). OTS.

Investigations were made to determine a basis for the evaluation of the ability of weld flaws to initiate brittle fracture. Studies of brittle fracture mechanics based on the Griffith theory and on Irwin's strain-energy release rate adaptations, static tests on flawed butt welds, static and dynamic tests on small butt weld flaws with and without residual stress, and static tests on weld flaws in a controlled field of high residual stress are reported. All welding flaws in selected materials were simulated flaws, varied to represent lack of penetration, porosity, lack of fusion, or sharp internal weld cracks. Effects of given flaws in various environments were examined in order to determine the environment essential to initiate brittle fracture under low static stress conditions. Low temperature was generally an essential part of the environment, but low static stress initiation could not be procured below the nominal yield point unless the static stress was augmented by either a dynamic stress or a high previously-incurred residual stress. The residual stress environment proved to be most significant. Brittle fractures were initiated from short internal cracks with as little as 2000 psi of applied static stress at temperatures in the order of 0°F. If total brittle fracture did not result, arrested fractures occurred from small buried flaws, with the arrested crack forming a potential source of fracture initiation. (auth)

19390 AEC-tr-4106

FORMATION OF CRACKS DURING SECTIONAL FORGING OF LOW-MALLEABILITY ALLOYS. M. V. Rastegaev. Translated from *Kuznecho-Shtampovochnoe Proizvodstvo* No. 11, 8-12(1959). 11p. JCL or LC.

The mechanism of the formation of surface cracks in sectional forging was studied for lead, a low-malleability alloy (Kh18N25S2), and brittle gray cast iron. The alloy was rendered malleable by previous forging at recrystallization temperatures. Surface crack formation in low-malleability alloys forged by flat dies is concluded to proceed in two stages: (1) displacement along the forging axis and fusion of adjacent particles and (2) shear at the fused location. Osipov's conclusion that failure along the forging axis would be caused by sharp die edges was not confirmed; regardless of the die profile, failure of the alloy and iron occurred along the forging axis. Forging axis-failure of low-malleability alloys can be prevented if forging is done under conditions of triaxial nonuniform compression. (D.L.C.)

19391 NP-tr-458

HANDBOOK FOR THE FOUNDRY WORKER—SHAPE CASTING OF ALUMINUM AND MAGNESIUM ALLOYS. (Spravochnik Liteyshchika—Fasonnoye Lit'ye iz Alyuminiyevykh i Magniyevykh Splavov). I. F. Kolobnev, V. V. Krymov, and A. P. Polyanskii (Polyanskiy). Translated from a publication of the State Publishers of Literature on Heavy Machine Building, Moscow, 1957. 407p. OTS.

The handbook gives the physical, chemical, and mechanical properties of Al and Mg and of their commercial alloys. Part one is devoted to shape casting of Al alloys. The composition, structure, and properties of cast Al alloys are presented. Chapter two is devoted to the charge materials

and calculation of the charge. In chapter three the methods and equipment used in the melting of Al alloys are described. Chapters four and five discuss the characteristics of molds and molding materials, along with filling the mold and trimming the castings of Al alloys. The last two chapters present casting control, measures for the prevention of rejects, and heat treatment of parts cast from Al alloys. (W.L.H.)

19392 SCL-T-312

THE METAL PHYSICS BASES OF PRESSURE WELDING. (Metallphysikalische Grundlagen der Press-schweissung). F. Erdmann-Jesnitzer. Translated by Marcel I. Weinreich (Sandia Corp.) from *Aluminium* **33**, 730-9(1957). 33p. JCL.

The processes are studied which take place in the bonding of metallic surface under pressure, temperature, and time forces and without the appearance of liquid phases; this bonding is commonly known as pressure welding. Crystal facets of NaCl were cemented together under light pressure, and the time required for the cementing process was determined at various temperatures. The time-temperature dependence was found to obey the equation $1/t = c_0 \exp(-Q/RT)$ down to a temperature of $0.7T_m$ (T_m = melting point). The following pairs welded together were studied in the same way: Cu-Cu, Al-Al, Al-Cu, and Al-Fe. The effect of grain size on welding was determined, especially for Al-Al, and the possibility of formation of new grains is considered, together with the effect of brushing treatment (abrasion) on the surface. A theory of cold pressure welding is developed in which the bonding is an interwelding of two metallic crystal planes with flattening of roughness peaks and formation of a quasi-fluid for a short period of time. The discussion is extended to other materials, e.g., plastics and glass, and to a variety of metal operations, e.g., sintering, plating, and cutting. (D.L.C.)

19393

EVAPORATED FILMS OF NIOBIUM. D. Shaw and B. N. Watts (British Thomson-Houston Co. Ltd., Rugby, Eng.). *Brit. J. Appl. Phys.* **11**, 304-5(1960) July.

The preparation of thin films of niobium by vacuum evaporation was investigated. Because of temperature requirements, the filament material was restricted to tungsten, tantalum, or carbon. Carbon had been reported to form niobium carbide with niobium at 1700°C. Tungsten and tantalum had been found to form solid solutions with niobium. Using a tungsten filament, an evaporated deposit of 16% niobium and 84% tungsten was formed. Using a tantalum filament, films of 72% niobium and 28% tantalum, 69% niobium and 31% tantalum, and 50% niobium and 50% tantalum were deposited. These films were used to prevent the interaction of uranium and aluminum when heated in contact. (M.C.G.)

19394

THE NITRIC-HYDROFLUORIC ACID PICKLING OF ZIRCALOY-2. M. A. DeCrescente, P. F. Santoro, A. S. Powell, and R. H. Gale (Combustion Engineering, Inc., Windsor, Conn.). *J. Electrochem. Soc.* **107**, 591-3(1960) July.

The dissolution of Zircaloy-2 was studied in the temperature range 15.6 to 37.8°C in unagitated and agitated hydrofluoric-nitric acid solutions. The dissolution rate was found to increase with HF concentration and agitation. The energy of activation for the Zircaloy-2 pickling process compares very well with the value for the unalloyed zirconium pickling process, 3.3 kcal/mole. The energy of activation does not depend on agitation. (auth)

19395

NICKEL CLADDING BY THERMAL DECOMPOSITION OF NICKEL CARBONYL VAPORS. A. M. Verblvskii and A. L. Rotinyan. *Zhur. Priklad. Khim.* **33**, 102-10(1960) Jan. (In Russian)

Nickel carbonyl vapors decompose to nickel and carbon monoxide on being contacted with a heated surface. A closed system is described wherein advantage is taken of this reaction to nickel-clad the heated surfaces of various objects by continuously circulating Ni(CO)_4 in a CO carrier. High-grade coatings of nickel can be obtained at 275 to 285°C with 20 to 25 vol % Ni(CO)_4 in the gas and at 270 to 310°C at 0.5 to 5 vol % Ni(CO)_4 . The oxygen content in the gas phase should not exceed 0.4 vol %. Since the thermal decomposition of Ni(CO)_4 is accompanied by an adsorption of heat, the rate of circulation of gas over the heated surface should be limited to 0.006 to 0.02 m/sec to control the temperature drop. The gas flow is periodically reserved to improve the uniformity of the coating. The cladding is weakly bonded irrespective of the metallic base, the roughness of the cladding, or the conditions of deposition. A thermal treatment in hydrogen for 30 minutes at 550 to 770°C results in a firm bond that is maintained even after repeated bending to an angle of 180°. If the temperature of deposition is not rigidly controlled, fine bubbles can be detected in the cladding. Tests show that coatings $>10 \mu$ in thickness are compact, non-porous, and resistant to corrosion when thermally treated with hydrogen at 550 to 700°C. Special measures must be taken to protect personnel from the poisonous effects of Ni(CO)_4 and CO. This method of nickel cladding is recommended over the electrolytic method whenever complicated shapes are to be clad, a less porous coating is desired, or a high-grade coating is not possible or very difficult by electrolytic methods. (TTT)

19396

LEVITATION FUSION OF CHROMIUM. N. V. Ageev, A. A. Fogel', T. A. Sidorova, and V. A. Trapeznikov (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Priklad. Khim.* **33**, 332-7(1960) Feb. (In Russian)

Samples of electrolytic and iodide chromium were levitation fused by induction heating in purified helium at 1.1 to 1.2 atm. Analyses showed that the principal impurities in the fused chromium samples were due to gaseous contaminants, particularly oxygen and nitrogen. The nitrogen content was lower in 25% of the samples, was unchanged in 73%, and increased a little in only 2% of the samples. The nitrogen content was 2.4% on fusion in air at atmospheric pressure, 0.076% on fusion in unpurified helium and 0.008% in purified helium. The average oxygen content was about 0.005%. The Rockwell hardness recalculated to a Brinell hardness was 115 kg/mm² for electrolytic chromium, and 108 to 110 kg/mm² for iodide chromium. Compression testing along one axis showed that the transition temperature (about 150 to 175°C) from the plastic to a brittle state was the same for iodide and electrolytic chromium. The relative contraction was 25 to 27% for the brittle region and 45 to 52% for the plastic region. Electrolytic chromium showed no tensile elongation until a temperature $>250^\circ\text{C}$ was attained, and even at 450°C the relative tensile elongation is only 3%. (TTT)

19397

INCORPORATION OF RADIOACTIVE W^{185} DURING THE ANODIC FORMATION OF A FILM OF Al_2O_3 . A. F. Bogoyavlenskii and G. N. Dobrotvorskii. *Zhur. Priklad. Khim.* **33**, 340-4(1960) Feb. (In Russian)

Anodic passivation of small plates of aluminum were

carried out in a 5% Na_2CO_3 solution containing $1 \mu\text{C}/\text{ml}$ and $10 \mu\text{C}/\text{ml}$ of W^{185} at a current density of $0.5 \text{ A}/\text{dm}^2$ at 100 to 110 v. The specific surface activity (I) decreased rapidly with an increase in temperature of the electrolysis above 20°C . I was found to be directly proportional to the specific activity of W^{185} in the electrolyte (I_1). The effect of time could be expressed by the equation: $I = a \lg \tau + b$, where I is the specific surface activity in $\mu\text{C}/\text{cm}^2$, τ is the time in minutes, and a and b are constants. The combined effects of time and specific activity of W^{185} in the electrolyte are expressed by the equation $I = I_1 (8.0 \lg \tau - 3.0) 10^{-5}$, where I is the specific activity of the oxide layer in $\mu\text{C}/\text{cm}^2$, I_1 is the specific activity of the electrolyte in $\mu\text{C}/\text{ml}$, and τ is the time in minutes. The data show that the activity of the samples increases with increasing current density and can be expressed by the equation $\lg I = -1.85 - 0.67/D_\alpha$, where D_α is the anodic current density in amps/dm^2 and I is the specific activity of the surface layer in $\mu\text{C}/\text{cm}^2$. The thinness of the anodic oxide layer of Al_2O_3 and the firmness with which the radioactivity is retained are desirable properties for a radioactive applicator. (TTT)

19398

PREPARATION OF GALVANIC COATINGS ON TITANIUM. S. M. Burdina and A. G. Samartsev. *Zhur. Priklad. Khim.* 33, 1141-6(1960) May. (In Russian)

The problem of electroplating Ti is complicated by the presence of a tenacious oxide layer on the surface, necessitating a chemical pretreatment of the metal by pickling with an etching solution containing various amounts of ethylene glycol, HNO_3 , HF, acetic acid, or ZnF_2 . Deposits of Cr, Cu, and Ni were prepared using modifications of the usual plating baths and experimental conditions. Heat treatment in vacuum of the 8 to 10μ base coat resulted in increased adherence, allowing a second deposition, forming 80 to 150μ layers. The adherence was measured by means of flexing and scratching tests. (TTT)

19399

IMPROVEMENTS RELATING TO MOULDS FOR THE CASTING OF METALS. Albert Ronald Clifton Westwood (to Imperial Chemical Industries Ltd.). British Patent 834,864. May 11, 1960.

A method of preparing graphite molds for the casting of metals is reported. The manufacture of the mold consists of preparing a graphite powder pattern in which a thermosetting resin is incorporated and then carbonizing. (W.L.H.)

19400

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Jack Williams and William Munro (to United Kingdom Atomic Energy Authority). British Patent 837,853. June 15, 1960.

A method is reported for the production of Be-clad U fuel elements. The U rod is inserted in a hole in the Be body, closing the body with a Be plug, and extruding within the temperature range 420 to 450°C . (W.L.H.)

19401

IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF NUCLEAR FUEL ELEMENTS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 837,878. June 15, 1960.

A process is presented for the manufacture of clad fuel elements. The process consists of filling a sheath or can in a pressure mold with powder fuel, compacting with pressure ram, and solidifying with cold-pressing, hot-pressing, or sintering. (W.L.H.)

19402

METHOD OF MAKING FUEL ELEMENTS. (to United

States Atomic Energy Commission). British Patent 837,930. June 15, 1960.

A method is described for cladding a metallic core of a fuel element and roll-bonding the cladding to the core. (W.L.H.)

19403

PLATES WITH OXIDE INSERTS. (to U. S. Atomic Energy Commission). British Patent 840,753. July 13, 1960.

The design is described of reactor fuel elements in which the oxide fuel is in the form of pellets housed in a plate-like construction. The oxide fuel pellets are positioned in rows of passages in plates that are attached to one another with spaces in between for coolant to heat exchange with the fuel pellets. The fuel pellets are thermally bonded to the passages in the plates by a lead filler, which dispenses with the need to finish the passages and pellets to exact size. (W.L.H.)

19404

FORMING TUBES AND RODS OF URANIUM METAL BY EXTRUSION. (to United Kingdom Atomic Energy Authority). British Patent 840,792. July 13, 1960.

Methods and apparatus are presented for the extrusion of uranium into rods, tubes, and other elongated shapes. In the extrusion the uranium billet is heated in an inert atmosphere to a temperature within the gamma phase of the uranium and then extruding the billet while still within the gamma phase. (W.L.H.)

19405

METHOD OF PRODUCING SHAPED BODIES OF BERYLLIUM. Trevor Robert Barrett, Geoffrey Courtnauld Ellis, and Ronald Andrew Knight (to United Kingdom Atomic Energy Authority). British Patent 840,857. July 13, 1960.

A procedure is presented for the production of shaped bodies of Be by powder metallurgy. Beryllium powder of particle size not greater than 80 microns is placed into a mold and sintered, with no external pressure applied to the mold before or during sintering. The sintering is preferably effected in vacuo. The sintering should be carried out at a temperature of 1150 to 1250°C for about 6 hrs. (W.L.H.)

Properties and Structure

19406 ABMA-DV-TN-67-58

Army Ballistic Missile Agency, Redstone Arsenal, Ala. CRITERIA IN THE SELECTION OF MATERIALS FOR HIGH TEMPERATURE STRUCTURES. Wolfgang H. Steurer. July 1958. 49p.

Presented at the 3rd Symposium, High Speed Aerodynamics and Structures, San Diego, California, March 25-27, 1958.

A review of materials and aspects of selection for use in high-temperature structures is presented. Included are discussions on correlation of flight requirements and material characteristics, high-temperature structure design principles, structures based on the principal of heat resistance, those based on the principal of heat protection, and those based on the principal of heat absorption. The time-temperature criterium for selection of materials is also discussed. (J.R.D.)

19407 AE-32

Aktiebolaget Atomenergi, Stockholm. STRUCTURE INVESTIGATIONS OF SOME BERYLLIUM MATERIALS. I. Fäldt and G. Lagerberg. Jan. 1960. 15p.

Metallographic structure, microhardness, and texture

were studied on various types of Be materials. It was found that Be exhibited its highest hardness values in directions perpendicular to the basal plane (0001). (C.J.G.)

19408 AFBMD-TN-59-15

Avco Corp. Avco-Everett Research Lab., Everett, Mass. HIGH TEMPERATURE BEHAVIOR OF TEFLON. Research Report 55. Tunis Wentink, Jr. July 1959. 16p. Contract AF04(647)-278. (AD-227521).

The properties of tetrafluoroethylene polymer at 300 to 800°K are reviewed. The pyrolysis of the plastic is treated, with emphasis on behavior under ablating conditions. An effective heat of vaporization at 760°K is calculated. New data on thermal conductivity and emissivity in the infrared are included. (auth)

19409 AFSWC-TR-60-6

Battelle Memorial Inst., Columbus, Ohio. THE EFFECTS OF IMPURITIES ON THE PROPERTIES OF TUNGSTEN. Final Report [for] December 1, 1958 to December 1, 1959. B. C. Allen, D. J. Maykuth, and R. I. Jaffee. Dec. 15, 1959. 101p. Project 8805. Contract AF29(601)-1589.

Studies on electron-beam-refined tungsten single crystals showed that small amounts of C, O, and N did not change the mode of deformation at 400°C. Oxygen and N appeared to have little effect and C tended to raise the recrystallization temperature, which was found to be 1200 to 1500°C. Carbon and probably O caused refinements in the recrystallized grain size. When the temperature of recrystallization was increased above 2000°C, the recrystallized grain sizes of all specimens tended to approach the same value. The addition of certain refractory oxides, nitrides, and carbides raised the recrystallization temperature of powder-metallurgy tungsten, around 1600 to 1700°C, to 1800°C. Some additions refined the grain size and caused columnar grain formation. The bend ductile-brittle transition temperature was lowered from 230 to 150°C for wrought and from 420 to 330°C for the recrystallized condition by the presence of 2 vol.% of zirconia or thoria plus sodium oxide. The ductile-brittle transition temperature for wrought and recrystallized single crystals was 320°C. (auth)

19410 AMC-TR-59-7-767

Republic Aviation Corp., Farmingdale, N. Y. FORMABILITY OF INCONEL X. PART III. DESCRIPTIVE TEXT AND DATA. Final Engineering Report [for] October 15, 1958–October 15, 1959. R. Germann and C. J. Shaver. Nov. 30, 1959. 109p. Project No. 59-7-767. Contract AF33(600)-38042. (MRP-58-71).

Preliminary bend tests were conducted on Inconel X sheet material in the annealed and aged condition. Fabrication limits and techniques were determined for the more difficult manufacturing and forming operations. During the preparation and fabrication of specimens and representative airframe structural parts, data were obtained relative to the quality of sheared edges on sheet material, band sawing methods, light machining of sheet stock, abrasive cleaning and deburring, contamination tests, notch sensitivity, and marking methods. Mechanical and chemical descaling tests were conducted to ascertain performance and the suitability of either process in order to specify the most effective one for the removal of oxide films or scales formed at processing temperatures. Mechanical property and heat treatment studies were made relative to surface contaminations. The need for interstage anneal, its effects on subsequent forming and properties of the material was studied and evaluated. Engineering test data are presented with reference to the

need for stress relieving or annealing after forming and prior to and subsequent to welding. Data are presented on the extent of warpage, growth, shrinkage, and/or distortion resulting from the heat treatment process. (See also AD-226215.) (auth)

19411 ANL-4992

Argonne National Lab., Ill. PHYSICAL AND MECHANICAL PROPERTIES OF SOME ALUMINUM-LITHIUM ALLOYS. Final Report—Metallurgy Program 4.6.2. H. H. Chiswick, W. M. Lehrer, and S. P. Rideout. Nov. 18, 1952. Decl. Mar. 15, 1960. 42p. Contract W-31-109-eng-38. OTS.

A literature survey of room-temperature properties of Al-Li alloys was made. The eutectic composition was determined by thermal analysis and metallographic work. Heating and cooling curves were obtained at constant, reproducible rates, and the liquidus and eutectic temperatures were plotted as a function of alloy composition. The tensile strength, yield strength, elongation, reduction of area, Young's modulus, and hardness were determined for as-cast and as-extruded alloys at room temperatures. The short-time elevated temperature tests on alloys are summarized. Metallographic examinations of alloy samples were made to determine the time necessary at 550°C to solution-treat the as-extruded alloy. Microstructural changes resulting from heating for various times at 550°C and the effects of the rate of water and oil quenching from 550°C are shown. (C.J.G.)

19412 ANL-6127

Argonne National Lab., Ill. THE DIFFUSION OF GOLD IN GAMMA URANIUM. S. J. Rothman. May 1960. 18p. Contract W-31-109-eng-38. OTS.

The diffusion coefficient of tracer amounts of Au¹⁹⁸ in gamma U is described by an Arrhenius-type equation: $D = 4.86 \times 10^{-3} \text{ cm}^2/\text{sec} \exp(-30,400 \text{ cal/mol}/RT)$. The values of D_0 and the activation energy are close to those for self-diffusion in gamma U, indicating that the low activation energy for self-diffusion is due to a general weakness of the lattice rather than to easy compressibility of the U atom. (auth)

19413 ARF-2165-6

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

IMPROVED VANADIUM-BASE ALLOYS. Summary Report [for] December 1, 1958 to December 1, 1959. B. R. Rajala and R. J. Van Thyne. 34p. (AD-231512)

Promising V-Ti-(Cb, Mo, Ta, W) sheet alloys were investigated, since vanadium-base materials exhibit an excellent combination of fabricability, strength at elevated temperatures, and weldability. Alloying behavior was determined by the following property evaluations: 1200°F creep, 2000°F short-time stress-rupture, and room temperature, 1200, 1800, and 2000°F tensile data. This program was not concerned with oxidation protection; tests were performed in inert atmospheres because of excessive oxidation in air above 1245°F by formation of liquid V₂O₅. One of the most promising alloys, V-5 wt.% Ti-20 wt.% Nb, exhibits tensile strengths of approximately 70,000 and 50,000 psi at 1800 and 2000°F, respectively, and a 15-min rupture-strength of 33,000 psi at 2000°F. On a density-corrected basis, these data compare favorably with the properties of the best available sheet materials for 2000°F. An aged V-5 wt.% Ti-20 wt.% Nb-1 wt.% Si alloy offered promise at 1200°F; the stress to produce 0.1% plastic deformation in 100 hours was 50,000 psi. (auth)

19414 BMI-1133(Del.)

Battelle Memorial Inst., Columbus, Ohio.

SURVEY AND SELECTION OF MATERIALS FOR PROGRAMMATIC EVALUATION FOR A GAS-COOLED REACTOR EXPERIMENT. Donald L. Keller, ed. Sept. 20, 1956. Decl. with deletions Dec. 4, 1959. 86p. Contract W-7405-eng-92. OTS.

A survey and selection of materials were made for programmatic evaluation for gas-cooled reactor experiment. This survey was the basis for twenty or more research projects. Nitrogen, carbon dioxide, and air were considered as coolants. The nitrogen system was the simplest and, therefore, was selected as the reference coolant gas. The requirement that the power plant be small and portable eliminated graphite, beryllium, and beryllium oxide as moderators; on the basis of a preliminary survey of possible hydrogenous moderator materials, calcium and zirconium hydrides were chosen for further consideration. Of the elements possessing a large thermal-neutron-absorption cross section, boron, cobalt, cadmium, and some of the rare earths were selected as potential control materials. Stellite 25, a cobalt-base alloy, was chosen as the reference material because of its availability and low cost. A dispersion-type fuel element of the stainless steel- UO_2 type was immediately selected as the reference fuel element. The material problems arising from the selection of nitrogen gas as a coolant were studied. A limited reactor design study was carried out to guide materials work. The basic requirements for in-pile loop tests were set up for the program. The main objectives of the research programs resulting from this survey were outlined. (M.C.G.)

19415 BMI-X-156

Battelle Memorial Inst., Columbus, Ohio.

ANALYSIS OF THE AMOUNT OF PREFERRED ORIENTATION BY X-RAY DIFFRACTION LINE INTENSITIES. D. A. Vaughan. June 30, 1960. 11p. Contract [W-7405-eng-92]. OTS.

An analysis of x-ray-diffraction theory for the para-focusing diffractometer which involves a correction to the intensity formulas given by other workers for the case of reflection from a thick block of randomly oriented powder is presented. Experimental tests of the theory were made with NaCl both in powder form and as a single crystal and then applied to rolled tungsten specimens. (J.R.D.)

19416 CoA-121

College of Aeronautics, Cranfield, Bucks, England.

GRAPHITE AS A STRUCTURAL MATERIAL IN CONDITIONS OF HIGH THERMAL FLUX. A SURVEY OF EXISTING KNOWLEDGE AND AN ASSESSMENT OF CURRENT RESEARCH AND DEVELOPMENT. A. J. Kennedy. Nov. 1959. 42p.

The properties, crystallography, and manufacture of graphite are reviewed. (C.J.G.)

19417 DEGR-86(R)

United Kingdom Atomic Energy Authority. Development and Engineering Group. Library and Information Dept., Risley, Lancs, England.

ALUMINIUM DATA MANUAL—PROPERTIES OF INTEREST IN REACTOR DESIGN. B. J. Seddon, comp. Jan. 5, 1960. 51p. BIS.

A compilation of the best available data on the physical, mechanical, and chemical properties of aluminum and some of its alloys is presented. Irradiation and thermal cycling effects are included. (J.R.D.)

19418 KAPL-M-NMA-1

Knolls Atomic Power Lab., Schenectady, N. Y.

RÉSUMÉ OF INCONEL DESIGN INFORMATION. G. C.

Wheeler. Feb. 3, 1960. 11p. Contract W-31-109-Eng-52. OTS.

Data on the metallurgical, mechanical, and physical properties of Inconel which are pertinent to nuclear plant equipment design are compiled. (C.J.G.)

19419 LMSD-288139(Vol. II)(Paper 6)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ON DETERMINING BIAxIAL-STRESS YIELD AND FRACTURE CRITERIA FOR HOT PRESSED BERYLLIUM AT ROOM AND ELEVATED TEMPERATURE. R. F. Crawford. Paper 6 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 37p.

The classical criteria for yield and fracture strengths of materials in biaxial states of stress must be applied selectively. The proper selection depends upon the particular metallurgical mode of failure involved, which, even for a given material, depends upon the particular biaxial state of stress as well as other factors. In the case of beryllium, added complications can arise from directionalities that are the result of preferred orientation of the grain lattice structure. The above considerations are discussed and modified criteria for yield and fracture are introduced to account for preferred orientations. Recommended testing procedures are presented along with a brief bibliography. (auth)

19420 LMSD-288195

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

PELTIER EFFECT AND THERMAL-CONDUCTIVITY MEASUREMENT TECHNIQUES FOR THERMOELECTRIC MATERIALS. Kenneth D. Carroll, comp. June 1959. 135p.

A selective bibliography covering the period 1950 to 1958 is contained. The literature of particular interest is that of the Peltier, Seebeck, and Joule-Thompson Effects as well as certain studies of thermal conductivity. The tellurides, in particular lead telluride, was the only thermoelectric material designated as being of primary interest. There was, therefore, no attempt to cover the rapidly expanding field of thermoelectric materials. Semiconductors were only of tangential interest; hence, reference is made only to those writings that were of interest to those who had originally requested compilation of the bibliography. (auth)

19421 LMSD-288218

Lockheed Aircraft Corp. Missile and Space Div., Sunnyvale, Calif.

ELECTRICAL RESISTIVITY OF BERYLLIUM. Technical Memorandum. J. Ho and E. S. Wright. Jan. 1960. 24p. Contract NOrd 17017.

This paper was originally printed under the same title in Vol. II, "Metallurgy and Chemistry," of General Research in Materials and Propulsion, January 1959—January 1960, LMSD-288140.

Research concerning the effects of impurities on the electrical resistivity of beryllium is described. Investigation of the electronic structure of this metal is also discussed along with a study of the relationship of its electrical and thermal conductivities. (J.R.D.)

19422 NAA-SR-4898

Metal Hydrides Inc., Beverly, Mass.

THE PERMEATION OF HYDROGEN THROUGH HASTELLOY B. D. W. Rudd, D. W. Vose, and J. B. Vetrano. June 15, 1960. 17p. For Atomics International. Div. of North American Aviation, Inc. Contract AT-11-1-GEN-8, Subcontract N9-S-515. OTS.

The flux of hydrogen gas through Hastelloy B, hot forged to 20% reduction, was determined as a function of membrane thickness, pressure differential, and temperature. The experimental data were fitted to the following equation:

$$J = \frac{16.79 P^{1/2}}{X} \exp\left(\frac{-8470}{T}\right). \text{ (auth)}$$

19423 NAA-SR-Memo-3641

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

STRENGTH TESTS ON LOW-MELTING-POINT ALLOY SEAL. R. S. Kennedy. Apr. 22, 1959. 11p. OTS.

The top shield of the SRE is sealed against helium leakage by a tongue-and-groove seal composed of a 50% Bi, 27% Pb, 13% Sn, and 10% Cd alloy. The interfacial shear strength of the bond between type 304 stainless steel and the alloy was determined. The effect of pre-tinning the stainless steel upon the interfacial bond strength was studied. The effect of temperature (up to 110°F) on the interfacial bond strength was determined. An analysis of the resistance of the interfacial bond to short- and long-term loads was made. (C.J.G.)

19424 NAA-SR-Memo-4579

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

COMPARATIVE PROPERTIES OF DISPERSION-ELEMENT COMPONENTS. J. Kroehler, Jr. Sept. 23, 1959. 11p. OTS.

Patented fissile materials and matrices available for use in OMR were compared. Thermal conductivities, coefficients of thermal expansion, cross sections, and relative amounts of wt.% contributed to the fuel element were compared for ten matrix materials. The most promising of these appeared to be Al, Be, Mg, and Zr. Uranium contents, absorption cross sections, and relative stabilities were compared for fifteen fissile materials. The most promising of these dispersants appeared to be UC, UO₂, UC₂, UN, and U₃Si₂. (M.C.G.)

19425 NAA-SR-Memo-5252

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ELEVATED TEMPERATURE WEAR CHARACTERISTICS OF ZIRCALOY-2 AND TYPE 304 STAINLESS STEEL IN CONTACT WITH HASTELLOY-X. J. A. Roberson. Feb. 29, 1960. 13p. OTS.

Wear characteristics of Zircaloy-2 and type 304 stainless steel when in sliding contact with Inconel-X, Hastelloy-X, and Haynes-25 were determined at 1050 and 1400°F. (C.J.G.)

19426 NAA-SR-Memo-5330(Rev.A)

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

COMPATIBILITY OF UO₂ AND APM-M-257, REVISION OF TDR-4270. K. Langrod. May 25, 1960. 7p. OTS.

Compatibility tests on UO₂ pressed together with the aluminum alloy APM-M-257 and encased in stainless steel revealed no reaction after 6 months exposure at 1100°F. (C.J.G.)

19427 NP-8732

Climax Molybdenum Co. of Michigan, Detroit.

ARC-CAST MOLYBDENUM AND TUNGSTEN BASE ALLOYS (1957-1959). M. Semchyshen and R. Q. Barr. 206p. Project NR 039-002. Contract Nonr-2390(00). OTS.

Binary arc-cast alloys varying from 100% molybdenum to 100% of a second element (Nb, Ta, V, W, or Hf) were studied. All systems were evaluated for hardness, micro-

structure, lattice parameter, oxidation resistance, and forgeability. Arc-cast ingots were prepared for the binary systems of Mo with W, Ta, and V. The strengthening mechanisms in Mo and Mo-Ti alloys containing small additions of zirconium, carbon, hafnium, or boron were investigated. Tensile properties of Mo alloys were determined. Improvements in the ductility of Mo alloys, particularly in cast niobium, were attained by using the electron-beam melting technique. Ingots of Ti-W and Nb-W of the graded-composition type were prepared and evaluated in the cast state for hardness, lattice parameter, oxidation rates, and macrographic and micrographic evaluations. Elastic moduli were determined for Mo and Mo alloys from room temperature to 2400°F. (See also NP-5897(Suppl.)) (C.J.G.)

19428 NP-8830

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.

REFACTORY ALLOYS FOR USE AS STRUCTURAL MATERIALS IN RE-ENTRY OR BOOST GLIDE VEHICLES. Quarterly Report No. 1 for the Period Covered from June 1 to September 1, 1959. 126p. For McDonnell Aircraft Corp. Contract AF33(616)-6578.

The major portion of an alloy survey, made to determine candidate alloys for the construction of a structural component of a re-entry vehicle to be tested at 2500°F, was completed. Mechanical properties, recrystallization characteristics, and oxidation behavior are reported. One Nb alloy and three Mo alloys were identified that are semi-commercially available and that show potential for the above application. The Nb alloy F48 and the Mo alloy with the highest temperature capability, TZC, both require further processing development. Because of the desirable advantage the high strength Nb alloy has over Mo in oxidation resistance and reliability, and since two suitable Mo alloys (0.5Zr, and 0.5Ti-0.07Zr) are reasonably readily available, emphasis was placed on initiating process studies of F48 alloy: i.e., arc melting and sheet rolling. Considerable process information and development, including sheet bar extrusion, in-process coatings, and chemical analysis for Nb, acquired previously are reported. A survey of joining and fabrication procedures for Nb and Mo alloys reveals the state of the art, with respect to Mo, is far advanced over Nb alloys. Strong ductile spot weld joints were obtained in one Nb alloy (82) compared to the brittle welds encountered with Mo. Welding, mechanical fasteners, brazing, forming, and machining are discussed. Although a comprehensive review of protective coatings uncovered a need for a large integrated program to solve the needs for "flight" coatings, there is no question that coatings are available to meet the requirements of this program. (auth)

19429 NP-8833

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 17 [for] February 1, 1960 to April 31, 1960. C. R. Mason, J. D. Walton, M. D. Bowen, W. T. Teague, and C. A. Murphy. 44p. Project A-212. Contract NOrd-15701.

New heater plates for the thermal conductivity apparatus were checked with excellent results. It was found that the thermal conductivity of unicellular, foamed fused silica increased rapidly with increased temperature, but at a higher mean temperature than expected. This resulted from non-uniformity of cell structure and the inclusion of carbon and other impurities trapped in the cell walls and voids. The maximum heat flux measured in the exhaust of a 40-kw

arc-plasma unit was 500 Btu/(ft² sec). Thermal expansion measurements were made on alumina, titania, and zircon using a fused quartz type expansion apparatus. Indicated tensile strengths, determined with a Dillon Dynamometer, of arc-sprayed alumina, tungsten, and Metco 101 were in the 4000 to 5000 psi range. A study of the effect of varying thermite content on thermets having a final composition of 65% chromium and 35% beryllium oxide was confused by inadvertent use of coarser materials than were used in previous studies. However, the best properties were obtained in thermets whose original thermite content was 40 to 45%. Chromic oxide slips were formed from -20 + 50-mesh material in a water-calcion solution with less than half the amount of water necessary when no calcion and finer mesh starting material was used. Chromium carbides Cr₃C₂ and Cr₇C₃ were identified by x-ray analysis in the products of a thermite reaction whose reactants were beryllium, chromic oxide, and graphite. Thermets containing beryllium oxide and silicon carbide were formed in preliminary investigations. (M.C.G.)

19430 NP-8844

Pennsylvania State Univ., University Park.
SCABBING AND PULSE PROPAGATION IN MATERIALS.
Interim Technical Report No. 14 [on] SCABBING AND FRACTURE OF MATERIALS BY STRESS WAVES (thesis). Sudhir Kumar. Aug. 1, 1958. 120p. Project No. TB 2-0001 (1253). Contract DA-36-061-ORD-465.

A theoretical study is presented for the damage in simple shapes caused by pressure pulses of various shapes propagating uniaxially. The damage is composed mainly of scabbing and permanent deformation, and both elastic and elasto-plastic material behavior are considered. Special analytic methods are developed for the case of loads of longer duration than a fraction of a second. Shapes such as bars and plates are selected so that uniaxial stress propagation can easily be produced and, for the analytic studies, physical constants (density, Poisson's ratio, etc.) of aluminum and steel are assumed. (D.L.C.)

19431 NP-8852

California. Univ., Berkeley. Minerals Research Lab.
THE GROWTH OF PRISMATIC DISLOCATION LOOPS DURING ANNEALING. Technical Report No. 20. C. A. Johnson and E. R. Parker. May 1960. 23p. Contract Nonr-222(52). OTS.

Recent observations of the growth of quenched-in dislocation loops during annealing of aluminum are discussed. A mechanism for the coalescence of loops is proposed which depends on short-circuit diffusion around the periphery of prismatic dislocation loops. This mechanism is contrasted with the theory of loop coalescence by vacancy diffusion through the matrix. It is shown that the experimental observations are in better accord with the short-circuit diffusion theory. Interpretation of the experimental observations on the basis of the short-circuit diffusion mechanism leads to a value for the activation energy for diffusion along a dislocation line. For aluminum this value is calculated to be 0.7 ev. (auth)

19432 NP-8855

Brown Univ., Providence. Metals Research Lab.
THE RELATION BETWEEN THE PLASTIC DEFORMATION OF ALUMINUM SINGLE CRYSTALS AND POLYCRYSTALS. Final Report. Stephen Howe and Charles Elbaum. May 1, 1960. 29p. Contracts Nonr-562(12) and Nonr-562(27).

Single crystals of {100}, {111}, and {110} axial orientation, and polycrystals, both of 99.99% pure aluminum, were deformed in tension at temperatures of 27, 200, 400, and 600°C. The experiments on single crystals revealed that as

the temperature increased, the shear stress-shear strain curves for the three orientations became more and more similar until at 600°C they were identical. On the other hand the surface appearance of the crystals strained at 600°C indicated that the mode of deformation depended drastically on orientation. Taylor's criterion for the comparison of the stress-strain curves of single and polycrystals was found to be valid at 27°C. As the temperature was raised, however, the criterion ceased to be applicable. From the results of these experiments it is proposed that at the lower temperatures in both single crystals and polycrystals the principal hardening mechanism is the formation of Lomer-Cottrell barriers that act as obstacles against which glide dislocations can pile up. As the temperature is raised these barriers become ineffective as obstacles to slip, whereas grain boundaries in polycrystals continue to be effective in causing dislocation pile-ups. (auth)

19433 NRL-5481

Naval Research Lab., Washington, D. C.
LOW TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTIVITY AND THERMOELECTRIC POWER OF PALLADIUM AND PALLADIUM NICKEL ALLOYS CONTAINING ABSORBED HYDROGEN. A. I. Schindler, R. J. Smith, and E. W. Kammer. Mar. 7, 1960. 8p.

Electrical resistivity and thermoelectric power measurements were made on a series of hydrogen-containing palladium and nickel-palladium alloys. A two-phase region was known to exist at a hydrogen-to-palladium atom ratio of less than 0.6 while above this hydrogen concentration only a single-phase region exists. A resistivity maximum and, relative to pure palladium, a thermoelectric power minimum was found at T = 50°K for the palladium-hydrogen samples containing H/Pd ≥ 0.58. In addition, a resistivity minimum was found for these samples at approximately 90°K. At temperatures less than 80°K, the absolute thermoelectric power for Pd-H fell rapidly as a function of composition in the vicinity of H/Pd = 0.6. However, at temperatures greater than 90°K a maximum was found in the absolute thermoelectric power at H/Pd = 0.6. (auth)

19434 NYO-8029

Tufts Univ., Medford, Mass.
SOLID-LIQUID EQUILIBRIUM IN THE SYSTEMS LITHIUM SOLID-LIQUID EQUILIBRIUM IN THE SYSTEMS LITHIUM HYDRIDE-TITANIUM HYDRIDE AND LITHIUM HYDRIDE-ZIRCONIUM HYDRIDE. Charles E. Messer and Ira S. Levy. July 8, 1960. 9p. Contract AT(30-1)-1410. OTS.

Thermal analysis measurements were made on 8 mole % titanium hydride in lithium hydride, at hydrogen pressures of less than 1 atmosphere and at 10 atmospheres, and also on 8 mole % zirconium hydride in lithium hydride, at just under 1 atmosphere pressure of hydrogen. The observed freezing and melting points were identical with the melting point of pure LiH (688°C) within experimental error of about 1°. The titanium hydride was in some cases in the β phase and in some cases in the γ phase; the zirconium hydride was in the δ(ε?) phase. The results indicated that the degree of metallic interaction was sufficient to offset the ionic character and prevent measurable solubility of the TiH₂ and ZrH₂ in liquid LiH. (auth)

19435 OOR-2060.3

Brown Univ., Providence.
THE INFLUENCE OF BASIC DESIGN AND PROCESSING VARIABLES ON THE PROPERTIES OF SINTERED WC-Co ALLOYS. J. Gurland. Apr. 1960. 42p. DA Project No. 599-01-004. Contract DA-19-020-ORD-4888.

The characteristic properties of sintered WC-Co alloys were found to be associated with the brittle nature of the

material. The effects of volume, surface finish, loading rate, and grain size upon fracture strength were determined. The effect of various processing conditions which affect the density, composition, and structure of the sintered carbide was evaluated. (C.J.G.)

19436 ORNL-2902

Oak Ridge National Lab., Tenn.

A FAILURE ANALYSIS FOR THE LOW-TEMPERATURE PERFORMANCE OF DISPERSION FUEL ELEMENTS.

J. R. Weir. June 15, 1960. 36p. Contract W-7405-eng-26. OTS.

An analytical approach is proposed which allows the burnup (by fission) of uranium required to cause failure in a uranium dioxide-stainless steel dispersion fuel element to be calculated. The analysis is developed by assuming the matrix of the fuel element to be made up of a uniform, close-packed array of spherical UO_2 particles, each surrounded by and associated with a hollow stainless steel sphere. Equations are then written for the amount of fission gas released into the stainless steel cavity in terms of the UO_2 particle size and density and the burnup. The release mechanism is by recoil only, since diffusion is unimportant for the particle sizes and temperatures ($<1000^\circ\text{F}$) of interest. The gas atoms recoiled from the UO_2 particle are assumed to diffuse from the stainless steel shell into the cavity. The pressure thus exerted inside the stainless steel sphere is computed by the application of a real gas law. A suitable failure criterion for an internally pressurized, heavy-walled metal sphere appears to be when the sphere becomes entirely plastic. An equation for the pressure at failure and displacements of the sphere is written in terms of the UO_2 loading and the yield strength of the steel. By combination with the previous expressions, the burnup required to cause failure is calculated. Thus, the effects of UO_2 density and particle size, temperature, strength of the matrix material, and UO_2 loading on the burnup at failure are predicted by the theory. (auth)

19437 TID-6120

Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.

ABSOLUTE GRAIN BOUNDARY ENERGIES IN COPPER.

R[obert] L. Fleischer. [1959]. 5p. Contract [AT(30-1)-1310]. OTS.

The Read-Shockley equation for grain boundary energies, used with copper annealed at 1065°C , is shown to agree at both large and small angles of disorientation. A discrepancy observed by Gjostein and Rhines is probably due to a small twist component in the tilt boundary. Two other possible sources of error, energy lowering by solute atoms segregating to edge dislocations in a tilt boundary and effective temperature lowering by slow cooling after annealing the boundary, are discussed. (D.L.C.)

19438 TID-6121

Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.

EASY GLIDE OF LEAD SINGLE CRYSTALS. Robert L. Fleischer. 1960. 16p. Contract [AT(30-1)-1310]. OTS.

Lead single crystals, like those of other face-centered cubic metals, show easy glide, the amount increasing with the quantity of dissolved impurity and decreasing with the quantity of insoluble impurity. Like aluminum, lead has no linear second stage, but it shows no measurable creep at 4.2°K . The impurity effects may be understood with a model by Diehl. (auth)

19439 TID-6126

Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.

EFFECTS OF NON-UNIFORMITIES ON THE HARDENING OF CRYSTALS. R. L. Fleischer. [1959?]. 22p. Contract [AT(30-1)-1310]. OTS.

The ease of motion of a dislocation in a crystal is influenced by changes in lattice parameter and elastic modulus. For solid solutions where such changes are gradual the hardening is negligible, but for abrupt changes, such as occur at a precipitate, the effect is important. The changes in lattice parameter lead to the production of interface dislocations and suggest a work hardening model for one class of precipitation hardened alloys. Interface dislocations may also affect flow near a free surface. (auth)

19440 TID-6127

Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.

EASY GLIDE AND GRAIN BOUNDARY EFFECTS IN POLYCRYSTALLINE ALUMINUM. Robert L. Fleischer and William F. Hosford, Jr. [1960?]. 16p. Contract [AT(30-1)-1310]. OTS.

Studies directed at interpreting hardening of polycrystalline aluminum are described. Data for coarse-grained aluminum polycrystals suggest that the grain size effect is not due to dislocations piled up at grain boundaries but rather is primarily a relative size effect due to surface crystals being weaker and less confined. (auth)

19441 TID-6128

California. Univ., Berkeley. Materials Research Lab.

INVESTIGATION OF FACTORS CONTROLLING THE MECHANICAL PROPERTIES OF ALLOYS. Seventeenth Technical Report. Kurt Kennedy and Earl R. Parker. May 1960. 17p. Project No. 29. Contract AT(11-1)-34. OTS.

The interaction between dislocations, grain boundaries, and substitutional solid solution atoms was studied by means of a mechanical straining technique. The copper alloy containing 10% aluminum used for the experiments was vacuum cast, cold rolled, and then machined into tensile specimens. The specimens were recrystallized at various temperatures and quenched to room temperature in a blast of helium. An additional 500°C anneal was performed on part of the specimens to allow aluminum atoms to diffuse to the grain boundaries. The 500°C anneal was found to increase the yield strength of fine grain alloys by 30%. No effect was found in pure copper subjected to similar treatment. Migration of aluminum to grain boundaries was held to be the cause of hardening in the alloy. (auth)

19442 WADC-TR-59-29(Pt. II)

Brush Beryllium Co., Cleveland.

AN INVESTIGATION OF INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS.

Robert M. Paine, A. James Stonehouse, and Wallace W. Beaver. Feb. 1959. 129p. Project No. 7308, Task No. 73029. Delivery Order 33(616)-56-12.

The preparation, fabrication, and properties of intermetallic compounds under development for service at 2300 to 3000°F are described. The compounds, principally beryllides, have exhibited strengths, as measured by the modulus-of-rupture test, of $40,000$ psi at 2700°F and resistance to oxidation for 100 hours at 2800°F and have indicated good thermal conductivity. The compounds were prepared by solid-state reactions and fabricated chiefly by hot-pressing techniques. Oxidation tests were made in dry air at 2500 to 3000°F and in moist air (57°F dew point) at 2300 to 2500°F . Transverse-rupture tests were carried out at 2300 , 2500 , and 2750°F . Room-temperature hardness data and melting points are reported for some compounds. Thermal-expansion and thermal-conductivity data for selected compounds are also presented. The intermetallic compounds included in the investigations were NbAl_3 ,

TaAl₃, CrBe₂, MoBe₁₂, Nb₂Be₁₇, NbBe₁₂, TaBe₂, Ta₂Be₁₇, TaBe₁₂, TiBe₂, TiBe₁₂, ZrBe₁₃, Cr₃Si, Ti₅Si₃, TiSi, and TiSi₂, with CrBe₂, TaBe₂, TiBe₂, and the silicides receiving only a very limited effort (chiefly oxidation tests). The more promising intermetallic compounds for high-temperature applications are concluded to be ZrBe₁₃, Nb₂Be₁₇, NbBe₁₂, Ta₂Be₁₇, and TaBe₁₂. (auth)

19443 WADC-TR-59-278

National Bureau of Standards, Washington, D. C.
FACTORS CONTROLLING RESISTANCE TO DEFORMATION AND MECHANICAL FAILURE IN POLYCRYSTALLINE (GLASS-FREE) CERAMICS. Period covered: July 1, 1957 to December 15, 1958. John B. Wachtman, Jr., Wayne E. Tefft, Dick G. Lam, Jr., and Roger P. Stinchfield. May 1959. 81p. Project title: SOLID STATE RESEARCH AND PROPERTIES OF MATTER. Task title: MECHANISMS AND DEFORMATION BEHAVIOR OF SOLIDS. Contract AF33(616)-56-4. (PB-161112). OTS.

The elastic moduli and internal friction of several refractory oxide materials were studied. The six elastic constants of sapphire were measured with particular care and the results were found to differ from previously accepted values for four of these constants. Young's modulus for single crystal sapphire was found to decrease linearly with increasing temperature above 100°C. As the temperature was decreased below 100°C, Young's modulus first rose above the extrapolated high temperature straight line and then tended to become constant. The internal friction of single crystal sapphire was found to vary from 5×10^{-5} to 3×10^{-6} at room temperature. Annealing below 500°C decreased the value in a specimen with initially high damping. An internal friction peak was found in polycrystalline alumina with 15% lanthanum oxide additive. Young's modulus of uranium dioxide was measured as a function of temperature. Two internal friction peaks were found in polycrystalline zirconium oxide stabilized with 5% calcium oxide. These results are discussed. (auth)

19444 WADC-TR-59-279

General Electric Co. Research Lab., Schenectady, N. Y.
THE ROLE OF POLYGONIZATION IN CREEP. R. W. Guard. Feb. 1958. 51p. Project 7021. Contract AF33(616)-3263.

During creep at elevated temperatures dislocations form polygonal walls. Work is described which was carried out to determine the nature of the polygonization process and its importance in determining the creep rate of materials. The dislocation patterns formed during creep were studied, and the creep properties of specimens having preformed substructures were determined. The observations were carried out using a dislocation etch-pit technique and were supplemented by measurements of the change in creep rate in stress-decrement tests. The important conclusions of the work are that the polygonization process was accelerated by the stress present during the creep test, but gives structures similar to those observed on heating of deformed specimens. The size and density of subboundaries change considerably during a creep test even though the creep rate may remain constant. This indicates that it is not an obvious feature of the substructure which controls the creep rate. The substructures observed are similar to those observed by other workers using x-ray methods. A more detailed study of the behavior of dislocations in creep will be required before it is possible to make an adequate model for the creep process. (auth)

19445 WADC-TR-59-706

Illinois Inst. of Tech., Chicago. Armour Research Foundation.
INVESTIGATION OF GRAPHITE BODIES. [Period cov-

ered]: October 1, 1958 to November 1, 1959. Samuel W. Bradstreet, Leon M. Atlas, Seymour A. Bortz, H. Howard Lund, and H. Henry Nakamura. Oct. 15, 1959. 115p. Project 7350. Contract AF33(616)-6143. OTS.

The influence of composition and processing variables on certain properties of small, molded multicrystalline graphite was investigated. Non-impregnated specimens were made at densities above 1.8 gm/cc to exhibit flexural strengths in excess of 3500 psi at 20°C and 8000 psi at 2250°C. Techniques of differential thermal analysis and dilatometry for measuring tensile strength in brittle ring specimens, measurement of strengths and moduli to temperatures above 2850°C, and additions of a thermal carbon to coke flour as an interpacking aggregate were also examined. The value of furfuryl alcohol polymer as a binder was established. (auth)

19446 WADC-TR-59-771

Massachusetts Inst. of Tech., Cambridge.
THE EFFECTS OF STORED ENERGY AND RECRYSTALLIZATION ON THE CREEP RUPTURE PROPERTIES OF INTERNALLY OXIDIZED COPPER-ALUMINA AND COPPER-SILICA ALLOYS. Period covered: September 1, 1958 to September 1, 1959. Masao Adachi and Nicholas J. Grant. Dec. 1959. Project No. 7021. Contract AF33(616)-5424, Supplemental Agreement No. 2(59-428). OTS.

Copper-silica and copper-alumina alloys of low oxide content were produced by the internal oxidation and extrusion of copper-silicon and copper-aluminum alloy powders. These alloys show normal behavior after recrystallization. With increasing amounts of recrystallization at 1050°C, the creep rupture strength at 450°C decreases and the ductility increases. Cold work of the partially or completely recrystallized alloys results in an increase in creep rupture strength and a decrease in ductility. The strength of dispersed oxide hardened alloys of this kind is due to a combination of micron or sub-micron dispersion of an insoluble oxide and a high value of stored energy through cold work. In the as-extruded condition, both the dispersion and the cold work impede the dislocation movements. After recrystallization the only impediment to dislocation movement is the oxide dispersion. Improved ductility and higher creep rates are a result. (auth)

19447 AEC-tr-4115

STUDY OF THE DECOMPOSITION OF THE γ PHASE IN TERNARY U-Pu-Mo. Translated from Report No. 20, [presented at the] International Conference on Plutonium Metallurgy, Grenoble, [France], April 19 to 22, 1960. F. Anselin. 29p. JCL.

A study was made of γ -phase stability in ternary U-Pu-Mo alloys and the mechanism of decomposition. Homogenization of the alloys was measured by micrography and x rays. For treatments of short duration, the alloys were decomposed in a bath of melted salt, LiCl-KCl, at 325°. Thermal treatments were also conducted as follows: first decomposition at 500°C, quenching in an oil bath, and various microscopic and x-ray examinations. Then the process was repeated. Decomposition was accomplished in two stages. First, solid γ solution was enriched in molybdenum, while the zeta supersaturated phase was precipitated from α uranium. Second, after total disappearance of the γ phase of origin, the γ phase enriched in Mo was ordered by rejecting simultaneously uranium α and ξ phase. (M.C.G.)

19448 AEC-tr-4120

RELIEF EFFECTS ON THE CLEAVAGE SURFACES OF Zn, Bi, AND Sb CAUSED BY THE FORMATION OF TWINNED LAYERS. V. I. Startsev and V. N. Kosevich. Translated from *Fiz. Metal. i Metalloved.*, Akad. Nauk S.S.S.R., Ural'. Filial 2, 320(1956). 9p. JCL or LC.

The cleavage surfaces of Bi, Zn, and Sb crystals which were deformed by twinning were investigated. Irregularities on the cleavage surface near thin twins were measured with a MII-4 microinterferometer. These measurements showed that the zone of upheaval in the cleavage plane was 5 to 10 times as wide as the twin. The deflection angle of the cleavage plane and the angle between the cleavage plane and external surface of the twin were measured both with the interferometer and with x rays. The greatest deformations of the crystal lattice were at the intersection of twins and these deformations had a specific form. (M.C.G.)

19449 IGIS-91(RD/C)

PLASTIC DEFORMATION AND THE BEHAVIOUR OF HYDROGEN IN THE FORMATION OF FLAWS IN UN-ALLOYED STEEL. F. Erdmann-Jesnitzner. Translated by R. French (U.K.A.E.A., Risley) from Arch. Eisenhüttenw. 28, 355-65 (1957). 26p.

The effect of elastic deformation on the movement of hydrogen in the iron lattice and the influence of plastic deformation on the loss of hydrogen from cylinders formed of soft iron were determined. (W.L.H.)

19450 NP-tr-462

CHANGES IN STRUCTURE OF NICKEL DURING CREEP AND PROBLEM OF DETERMINING CONCENTRATIONAL DISTRIBUTION FOR ALLOYS FROM HETEROGENEOUS METAL POWDERS. [PART I]. A STUDY OF STRUCTURAL CHANGE OF NICKEL IN CREEP. G. Ya.

Kozirs'skii (Kozirs'skiy), V. A. Kononenko, and P. M. Okrainets'. [PART II]. ON THE PROBLEM OF DETERMINING THE DISTRIBUTION BY CONCENTRATIONS FOR ALLOYS OF HETEROGENEOUS METAL POWDERS. O. I. Raychenko. Translated from Ukrain. Fiz. Zhur. 3, 391-6; 408-17 (1958). 35p. OTS.

A new x-ray procedure was worked out for studying structural changes in grains of coarse-crystal materials during creep. The application of the new method to the investigation of creep in pure nickel at a temperature of 500°C and a load of 5 kg/mm² helped to reveal the peculiarity of the structural changes during the first and second stages of creep. It was shown that at the first stage grain crushing begins immediately after loading the specimen. The crushing of the grains and the increase in their mosaic angles were particularly intensive at the beginning of the test. These processes proceeded at a more rapid rate in large grains than in grains of small dimensions. At the second stage, grain crushing and increase in the mosaic angles proceeded less intensively. Deformation continued, chiefly, as a viscous flow along the boundaries of the grains and the resulting grain elements and their mutual turns. The grains themselves turned in respect to each other at angles of the order of 3°. Due to the movement of the grains the surface of the specimen became stepped, and cracks formed, along which the decomposition of the specimen took place. (auth)

19451

POTENTIAL METALLURGICAL USES OF DEPLETED URANIUM. Vincent D. Barth and George W. P. Rengstorff (Battelle Memorial Inst., Columbus, Ohio). Battelle Tech. Rev. 9, No. 7, 3-8 (1960) July.

U is available in depleted form (U²³⁵ removed) in large quantities, and the price is expected to drop as demand for it is increased. Knowledge of the metallurgic properties of U is limited, however, and more research on its potential uses must be done. Some of these uses are suggested from the known properties of U: it forms stable carbides, nitrides, oxides, and sulfides, so that it might be expected to find wide use as a scavenger of nitrogen,

sulfur, etc., in steels and as a deoxidizer in nonferrous alloys. U₃Si, recently investigated by the AEC, has considerable potential since it will not sink in liquid steel and it resists oxidation in air. U might also be used as a spheroidizing agent for making nodular iron, as strengthening agent in steel by dispersion hardening, and as a gamma ray shielding material superior to lead on a weight-for-weight basis. A list of two-component metal systems using U and their suggested uses is given. Because of the high density of U, it could be used as a densifying agent; it was found to give a high-density alloy with tungsten (W 90%, U 10%). (D.L.C.)

19452

INTERACTION OF CHROMIUM BORIDE WITH MOLYBDENUM. Shou-wei T'ai, G. A. Yasins'ka, and G. V. Samsonov (Academy of Sciences, Ukrainian, SSR). Dopovidi Akad. Nauk Ukr. R.S.S.R. No. 1, 48-50 (1960). (In Russian)

The properties of alloys in a pseudo-binary system CrB₂-Mo were investigated by means of metallographic, thermal, and dilatometric analysis, measurement of shrinkage during sintering, electrical resistance, and thermal emf. The diagram is eutectical, with two eutectics at 17 mol % CrB₂ (1960°C) and 94 mol % CrB₂ (2120°C), and little mutual solubility of the components in a solid state. A chemical compound Cr₂MoB₄ is found which melts congruently at 2270°. (auth)

19453

PROPERTIES OF MULTICOMPONENT NICKEL SOLID SOLUTIONS. I. I. Kornilov, L. I. Pryakhina, and L. A. Ryabtsev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 2, 110-14 (1960) Mar.-Apr. (In Russian)

The physico-chemical properties and equilibrium of Ni-Al, Ni-Cr-Al, Ni-Cr-Al-Ti, Ni-Cr-Ti-W-Al, Ni-Cr-Ti-W-Mo-Al, Ni-Cr-Ti-W-Mo-Nb-Al, and Ni-Cr-Ti-W-Mo-Nb-Co-Al alloys were investigated, and crystalline lattice, atomic diameter, and the diffusion of elements in nickel at 1200°C are tabulated. Constitution diagrams are plotted of the crystalline lattice, hardness, and electric conductivity of nickel alloys with variable contents of aluminum. It is shown that the crystal lattice distortions of nickel solid solutions are in progression with the location of alloying elements on the Mendeleev table. (R.V.J.)

19454

BORIDE ALLOYS WITH TRANSITION METALS AND OTHER METALS. M. S. Koval'chenko, G. V. Samsonov, and G. A. Yasinskaya. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 2, 115-19 (1960) Mar.-Apr. (In Russian)

Properties of pseudo-binary systems of ZrB₂-Mo, TiB₂-Mo, CrB₂-Mo, TiB₂-Cr, and ZrB₂-Cr were studied by visual thermoanalysis, by plotting shrinkage curves, measuring the micro- and macro-hardness, determining the melting point, and by metallographic and x-ray diffraction analyses. Hypothetical constitutions diagrams are plotted. (R.V.J.)

19455

ON SOME PROPERTIES OF WSi₂-NbSi₂ SYSTEM. N. V. Dokukina, M. D. Polyakova, and F. I. Shamrai. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo, No. 6, 102-9 (1959) Nov.-Dec. (In Russian)

The structure of WSi₂-NbSi₂ was studied by metallographic, x-ray diffraction, microhardness, hardness, electroconductivity, and melting point methods. It was found that the WSi₂-NbSi₂ cross section of the ternary system W-Nb-Si is a pseudobinary system. The phase diagram of the system is plotted, and it is shown that the

system does not have high heat resistance. A porous oxide film appears on the surface of the system at 1100 to 1200°C which does not protect the alloy from further oxidation. (R.V.J.)

19456

CONSTITUTION DIAGRAM OF TiFe_2 -V SYSTEM. Pi Ching-hua and I. I. Kornilov. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo*, No. 6, 110-12 (1959) Nov.-Dec. (In Russian)

Thermal and microstructure analyses were made and a constitution diagram was plotted for TiFe_2 -V. It is shown that the system is quasi-binary and the eutectics take place at a melting point of 1400°C. The components of the system are interdiffusing and two single phases (γ_1 and β) and one double phase ($\gamma_1 + \beta$) were observed. The solid solutions of $\text{TiFe}(\gamma_1)$ increase in hardness with the increase of vanadium. (R.V.J.)

19457

X RAY DIFFRACTION ANALYSIS OF CEMENTING PHASE IN WC-Co ALLOYS. A. E. Koval'skiĭ and L. Kh. Pivovarov. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo*, No. 6, 113-20 (1959) Nov.-Dec. (In Russian)

Effects of WC diffusion on the allotropic transformation in cobalt were studied. Tests were made of the allotropic modification, lattice period, grain and cementing phase intensity, and the influence of cobalt content on these characteristics. WC systems with 3, 8, and 20 wt.% Co sintered at 1250 (before cement melting), 1350, and 1420°C for 60 min and with 6, 15, and 25 wt.% Co sintered at 1380, 1440, and 1500°C for 40 min were tested. A fine cementing film was formed on the surface during sintering. The higher the content of Co, the thicker is the film. An increase in sintering temperature reduces the quantity of cobalt phase on the surface. The grain of the cobalt phase is larger than WC. (R.V.J.)

19458

ON THE STRUCTURE AND PHASE COMPOSITION OF SILICON DIFFUSION COATED NIOBIUM. P. M. Arzhanyl, R. M. Volkova, and D. A. Poroshkin. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk Met. i Toplivo*, No. 6, 127-9 (1959) Nov.-Dec. (In Russian)

The structure and phase composition of technical niobium saturated with silicon from the solid phase were studied at 1100 to 1300°C from 0.5 to 15 hours. A film of complex structure and composition was observed on the saturation process. The length of the saturation process does not change the microstructure of the film, and the ratio between the thicknesses of separate layers is retained. Tabulated data show that the weight of the specimen increases with increased temperature and time of saturation. (R.V.J.)

19459

FLUORESCENCE L SPECTRA OF Nb IN NbB_2 , NbC, AND NbN IN PURE NIOBIUM. M. I. Korsunskii and Ya. E. Genkin (Lenin Khar'kov Polytechnic Inst., USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 24, 401-4 (1960) Apr. (In Russian)

The L-series fluorescence in pure niobium and NbB_2 , NbC, and NbN were measured with a strong x-ray spectrograph focused by means of a convex quartz crystal ($\alpha_m = 4246.02^\circ$) with a 1000-mm radius. The fluorescence L spectra of niobium excited by characteristic L series emission of silver and L_α , L_{α_1} , L_β , L_{γ_1} , L_{β_2} , L_{β_3} , L_{β_4} lines of niobium and of a group of satellites of L_{α_1} and L_β were recorded with a microphotometer. The spectrograms are analyzed and results are tabulated. (R.V.J.)

19460

NIOBIUM L-SERIES FLUORESCENCE IN SOME COMPLEXES. M. I. Korsunskii and Ya. E. Genkin (Lenin Khar'kov Polytechnic Inst., USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 24, 470-2 (1960) Apr. (In Russian)

Studies were made of the niobium L-series fluorescence in compounds with nitrogen (6.32, 6.8, 8.1, 10.2, 11.9, and 12.6 wt.%) and with silicon and hydrogen. Observations showed strong variations in L_{β_2} and L_{γ_1} bands; the rest of the L spectra showed no noticeable changes. An analysis is made of L_{β_2} and L_{γ_1} bands at various nitrogen concentrations. (R.V.J.)

19461

THE REACTION OF ZIRCONIUM-OXYGEN ALLOYS WITH HYDROFLUORIC ACID. M. E. Straumanis and T. Ejima (Univ. of Missouri, Rolla). *J. Electrochem. Soc.* 107, 654-6 (1960) July.

The volumes of H_2 evolved by the dissolution of Zr-O mixtures in dilute HF were compared with those calculated from combustion analysis for O_2 in these mixtures. The calculations were made on the basis of the assumptions that dissolution in HF proceeded by the reactions (1) $\text{Zr} + 4 \text{HF} \rightarrow \text{ZrF}_4 + 2\text{H}_2$ for pure Zr and (2) $\text{ZrO}_x + 4 \text{HF} \rightarrow \text{ZrF}_4 + x\text{H}_2\text{O} + (2-x)\text{H}_2$ for Zr-O mixtures with composition Zr-xO , and that O_2 in the mixtures was in the form of ZrO_2 . The results were: Homogeneous Zr-O samples up to 29 at.% O_2 dissolved completely in 0.3 to 1 N HF, sometimes with the formation of a gray residue, which however was shown to be ZrOF_2 , a hydrolysis product. On the other hand, samples of the two-phase region (with more than 29 at.% O_2) left some white ZrO_2 residue, and homogeneous samples did likewise if heated previously to 600°C in a H_2 atmosphere. Samples with O_2 contents up to 27 at.% were used to check equations (1) and (2); the hydrogen volumes corresponded closely with a small error on the order of 1 to 2%, which was ascribed to absorption of O_2 as such in the Zr-O mixtures in the combustion analyses. (D.L.C.)

19462

PRESSING AND CALCINING OF POWDERED BORIDES. B. N. Babich, K. I. Portnoi, and G. V. Samsonov. *Metaloved. i Termicheskaya Obrabotka Metal.* No. 1, 31-5 (1960) Jan. (In Russian)

Powder metallurgical methods which previously were found useful for the preparation of hard boron-based compounds were investigated specifically for Ti and Cr borides and for their solid solution at a TiB_2 : CrB_2 ratio of 4/1. The starting materials used during the study were prepared by a vacuum-thermic method, while the binary boride was obtained by homogenizing the constituent powders at 1700°C. Pressures ranging from 0.5 to 8 tons/cm² were used for the pressing process while temperatures up to 2300°C were employed successfully, except for the pure CrB_2 which exhibited dissociation phenomena beyond 2100°C. A logarithmic correlation was established between the pressure applied and the bulk density obtained, as expected for metals. The result also showed that the method involving a separate pressing and sintering step is preferable to the complex and uneconomical hot pressing process. (TTT)

19463

HYDROGEN MOVEMENT IN ZIRCALOY-2 UNDER THERMAL GRADIENTS. C. N. Spalaris, A. E. Pickett, and G. G. Gaul (General Electric Co., San Jose, Calif.). *Nuclear Sci. and Eng.* 8, 83-5 (1960) July.

Hydrogen migration in Zircaloy-2 tubing with the application of a thermal gradient was studied. Hydrogen was introduced into the tubing by autoclaving at 850°F for several days in 1000 psi steam and a thermal gradient of 80°F

was obtained across the tubing wall by exposure to boiling water at 154 to 1600 hr. Hydrogen migration was observed in all cases, and the difference of migration in samples tested for 600 and 1600 hr is very small. In the 1600-hr sample, however, the hydride platelets appears to orient along specific paths in the tubing, the platelets being parallel to the extrusion direction and at angles to the walls of the tubing. The transverse ductility of hydride-redistributed samples is reduced appreciably up to 250°F for hydrogen contents down to 60 ppm. (D.L.C.)

19464

THE PREPARATION OF Th METAL IN COMPACT FORM BY ELECTROLYTICAL DEPOSITION FROM FUSED SALTS. Stefan Minc and Wadim Rafalski (Univ. of Warsaw and Inst. of Physical Chemistry, Polish Academy of Sciences, Warsaw). *Nukleonika* 5, 47-53(1960). (In Polish)

A massive, compact type of Th metal deposit was prepared by electrolysis from fused salts. The electrolyte was a mixture 0.4 N ThF₄, 0.5 N CaF₂, and 0.1 N ZnF₂. The operating temperature was 1100°C, and the current density 650 amp/square decimeter. The heat of the chemical reduction of thorium-salts by electrolytically deposited calcium caused an increase of the temperature of the melt above its melting temperature and the sublimation of zinc. (auth)

19465

SILICON NITRIDE. A New Ceramic for High Temperature Engineering and Other Applications. N. L. Parr (Admiralty Materials Lab., Poole, Eng.). *Research (London)* 13, 261-9(1960) July.

The compound silicon nitride can be prepared as a duplex ceramic body in which hard particles of full theoretical density are bonded by a felted mass of interpenetrating whisker growth. The nature and proportion of the felted phase can be varied to give final bulk densities of between 1.7 and 2.7 g/cc corresponding to approximately 50 and 15% porosity, respectively. The transverse rupture strength of the material so formed varies between 5 and 13 tons/in.² at temperatures up to at least 1200°C according to density, which also governs creep strength and hardness, but creep properties may be increased by incorporating a fine dispersion of silicon carbide throughout the felted phase. Its coefficient of thermal expansion is $2.5 \times 10^{-6}/^{\circ}\text{C}$ and its elastic modulus is 4000 tons/in.². It has excellent oxidation resistance at temperatures up to 1600°C and is dimensionally stable, even after prolonged exposure to these temperature levels. It has unique thermal shock resistance relative to other ceramics, and it can be produced simply and cheaply in a wide variety of shapes and forms to very close tolerances. (auth)

19466

MICRO-ZONE ANALYSIS OF CARBIDES ON THE FRACTURE SURFACE OF MOLYBDENITIC STEELS. L. V. Zaslavskaya and N. M. Popova. *Zavodskaya Lab.* 26, 135-7(1960). (In Russian)

It was previously established that cracks and fractures in steels often originate at the grain boundaries where alloying additives and carbides are usually considerably enriched. This question was investigated in the case of steels containing Mo and Cr-Mo-Ni additions. Fractured specimens were covered with an insulating layer except on the fracture face, which served as the anode of an electrolytic cell, the cathode was a Pt wire, 0.01 N HCl solution served as electrolyte. The cathodic deposits were analyzed microchemically for the elements of the solid solution. The MoC was determined by treating the fracture with a hot mixture of H₂O₂ and alcohol, evaporating the solution to

dryness and melting the residue with KNaSO₄ preparatory to microchemical analysis. For comparison, the unfractured surface was dissolved to a depth of 3 to 4 μ, about 2 mg of the metal, and used for zone-melting analysis. In many cases the difference between the two sets of values depended primarily on the steel composition and its thermal history. However, in steels containing only molybdenum the carbide phase contained nearly all the Mo; the sum of the Mo content of the carbide phase and of the solid solution even exceeded the average Mo concentration of the steel because of migration toward the grain boundary. The presence of Cr and Ni in the steel reduced this enrichment effect in the fracture surface. (TTT)

19467

POLARIZATION OF NUCLEI IN NON-METALLIC FERROMAGNETICS. G. R. Khutsishvili (Inst. of Physics, Academy of Sciences, Georgian, SSR). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1647-9(1960) May. (In Russian)

Polarization was studied in non-metallic ferromagnetics of the form XO·Fe₂O₃, when X is a divalent ion of a transition metal (Fe, Co, Ni, Mn, Ti, and Cu). These ferrites possess an inverse spinel structure in which X²⁺ occupies half the B position and Fe²⁺ all the A position and part of B. Considerable polarization of X is obtained at super-low temperatures; the maximum polarization is equal to unity. In ferrites (Fe₃O₄) the maximum polarization of iron nuclei was equal to 1/4. Ferromagnetic garnet 3X₂O₃·5Fe₂O₃, where X is a trivalent rare-earth ion, was also analyzed. In this case the X nuclei and iron nuclei are polarized at super-low temperatures; the maximum polarization of X nuclei is equal to unity and iron nuclei to 1/4. Thus, the polarization of ferromagnetic and some paramagnetic atoms can be achieved by superimposing magnetic fields on ferrite or garnet cooled to super-low temperatures. The obtained polarization can be measured by nuclear paramagnetic resonance and in the case of radioactive nuclei by investigation of γ angular anisotropy or β angular asymmetry. The latter is more convenient as it permits direct determination of the degree of polarization. The experiments can be applied to mixed ferrites and garnets with known structures. (R.V.J.)

19468

PROPERTIES OF ALLOYS OF THE TERNARY SYSTEM: NICKEL-CHROMIUM-TUNGSTEN. P. B. Budberg and K. I. Shakhova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 415-20(1960) Feb. (In Russian)

The electrical resistance, hardness, and high-temperature hardness of 32 alloys with a constant tungsten content of 5, 10, 20, and 30% and with a variable chromium content of 2, 5, 10, 15, 20, 25, 30, and 35% were investigated after two different heat treatments. Two sets of samples of each composition were annealed in vacuum at 1200°C for 24 hours and then at 1000°C for 100 hours. Then, one set of samples was quenched and the other set was further annealed at 800°C for an additional 100 hours and cooled in the furnace. It was shown that the specific electrical resistance of the alloy increases with increasing chromium content and attains a maximum in the regions where the ternary solid solution is saturated with respect to chromium and tungsten. Thus, the specific electrical resistance of the quenched, 5% tungsten alloy shows a maximum at a 35% chromium, while the annealed, 5% tungsten alloy shows a maximum at a 30% chromium. The electrical resistance of the quenched and annealed samples indicates that the solubilities of chromium and tungsten in the ternary solid solution of nickel vary with temperature. Tungsten is more effective than chromium in improving the hardness of the

alloy both at room temperature and at elevated temperatures. An increase in tungsten content of only 7 at.% with a constant chromium content of 9 at.% results in an increase of the hardness of the alloy of 24% at room temperature (from 162 to 201 kg/mm²). At a constant chromium content of 25% an increase in tungsten content results in an increase of hardness at moderate temperatures as compared with an alloy with a lower tungsten content. In addition the decrease in hardness at elevated temperatures is significantly smaller for alloys with a higher tungsten content. Thus, the hardness of an alloy with 5% tungsten and 25% chromium decreases by 24.7% on increasing the temperature from 100 to 500°C (from 190 to 143 kg/mm²). On increasing the tungsten content to 10%, the decrease in hardness is 22.9% (from 231 to 180 kg/mm²). At 20% tungsten the decrease is 17.4% (230 to 190 kg/mm²), and at 30% tungsten the decrease in hardness is only 9% (274 to 250 kg/mm²). Hardness values were determined at a loading of 10 kg. These data indicate the important role that tungsten plays in increasing the high-temperature hardness of alloys. (TTT)

19469

INVESTIGATION OF THE SOLID PHASES IN THE SYSTEM BeO-TiO₂. E. K. Keler and E. N. Isupova (Inst. of Silicate Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 433-6(1960) Feb. (In Russian)

Available data on the system BeO-TiO₂ are contradictory and the question as to the existence of beryllium titanate is still open. Mixtures of BeO and TiO₂ with stoichiometric ratios of 1:1, 2:1, and 3:1 were heated at temperatures of 450 to 1750°C. Whether using oxides or hydroxides as starting materials, no evidence of interaction could be observed to indicate the formation of beryllium titanate. X-ray analysis showed only the lines of the starting components. The densities of the calcined product were close to the densities of the corresponding mixtures of BeO and TiO₂. Selective leaching with HCl (1:1) and H₃PO₄ (1:5) left a residue in which only BeO and TiO₂ could be detected by x-ray analysis. The results of thermographic analysis indicated the absence of any interaction between the oxides. Microscopic analysis showed only the presence of two phases, one of which (BeO) fluoresced in ultraviolet light. Additions of up to 5% of Li₂O, Na₂O, MgO, ZnO, Al₂O₃, Fe₂O₃, B₂O₃, SiO₂, and P₂O₅ showed up only the starting components on x-ray analysis. It must be concluded that beryllium titanate is not formed in the system BeO-TiO₂. (TTT)

19470

STABILITY OF THE β -PHASE IN TITANIUM-VANADIUM ALLOYS. N. V. Ageev and L. A. Petrova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 615-18(1960) Mar. (In Russian)

The stability of the metastable β -phase was investigated from -196°C to 500°C with vanadium contents of 3.7, 12.8, 14.2, 15.1, and 19.3% on a base of titanium made by thermal reduction with magnesium. The results of microstructural and x-ray analyses of alloys quenched in water at 20°C show that the β -phase is fixed in an alloy with 19.3 wt.% vanadium on quenching from 850°C. The alloy with 15.1 wt.% vanadium quenched from 1000°C has a $\beta + \omega$ phase structure. The 3.7 wt.% vanadium alloy quenched from 900 to 1000°C has the structure of a super-saturated α -phase (α'). Alloys containing 16, 25, 30, 35, and 40 wt.% vanadium were prepared on a base of titanium made from titanium iodide. The iodide-derived titanium alloy with 15.6 wt.% vanadium had a $\beta + \omega$ structure on quenching from 900°C just as the titanium alloy with 15.1% vanadium with a base

of titanium derived by thermal reduction with magnesium. All the other alloys containing 24.4 wt.% vanadium and higher had a structure of a β -solid solution (the boundary line of the transition from the β -phase to an $\alpha + \beta$ phase for iodide-derived titanium alloys). The β -solid solution is stable at room temperature and lower, and at 100°C for 81 hours. On heating to 200 to 400°C the β -solid solution decomposes to an intermediate ω -phase which passes over into an α -phase on increasing the holding time and temperature. The stability of the β -solid solution increases with increasing vanadium content, particularly at 200 to 400°C. Thus, the β -solid solution alloy with 24.2 wt.% vanadium is stable at a temperature of 200 to 400°C for not more than 4 hours and 15 minutes, but the β -solid solution with 34.3 wt.% vanadium is stable for 100 hours at the same temperature. In the high vanadium content (28.8%) alloys the β -solid solution decomposes directly to the α -phase without going through an intermediate ω -phase, as the lower vanadium content (24.4% and lower) alloy does. The maximum hardness values were found for the $\beta + \omega$ structure. The hardness of the β -alloys is about the same as the $\alpha + \beta$ alloys. (TTT)

19471

STABILITY OF THE β -PHASE IN TITANIUM-VANADIUM-MOLYBDENUM ALLOYS. N. V. Ageev and Z. M. Rogachevskaya. Zhur. Neorg. Khim. 5, 619-21(1960) Mar. (In Russian)

Ti-Mo-V alloys quenched from 900°C, having a metastable β -phase structure, were heated at 100 to 600°C with a holding time of 15 minutes to 100 hours. Alloys containing 9.4 to 14.2% molybdenum and 5.9 to 13.9% vanadium generally show the same β -phase stability. The β -phase is preserved for a holding time of 100 hours at 100°C, 25 to 36 hours at 200°C, and 16 to 25 hours at 300°C. The β -phase then decomposes, forming an ω -phase. At 400 and 500°C the ω -phase appears in 15 minutes and is preserved at 400°C for 81 to 100 hours. The ω -phase is stable for 4 to 16 hours at 500°C and is then converted to an α -phase. The hardness increases with the appearance of the ω -phase and decreases with the appearance of the α -phase. Increasing the vanadium content to 20% had only a slight effect in improving the stability of the β -phase. An alloy with 21.1% molybdenum and 9.7% vanadium had the greatest β -phase stability at 100 to 400°C. The β -phase stability in Ti-Mo-V alloys increases with increasing molybdenum content. Data obtained previously on Ti-Mo-Mn alloys show that manganese is more effective than molybdenum in increasing the stability of the β -phase. Thus, the titanium alloy with 17.9% manganese and 4.6% molybdenum possess good β -phase stability on heating at 100 to 600°C, but the titanium alloy with 27.0% molybdenum and 3.8% manganese does not. Iron is more effective than manganese or vanadium in stabilizing the β -phase when added in amounts of 5 to 6% to a titanium-molybdenum alloy. (TTT)

19472

PHASE DIAGRAM FOR THE SYSTEM TITANIUM-TIN.

I. I. Kornilov and T. T. Nartova. Zhur. Neorg. Khim. 5, 622-9(1960) Mar. (In Russian)

Differential thermal analysis, microstructural analyses, and determinations of hardness values and electric resistance were used to construct a diagram of state for the binary system Ti-Sn up to the composition of the compound Ti₃Sn (from 0 to 25 at. % Sn). Analyses of the thermograms showed that all conversions proceeding with the absorption of heat could be detected on the heating curves. Tin lowers the temperature of conversion of titanium with 5.0 at. % tin first to a minimum at 860°C which then increases to 890°C

at higher tin contents. A peritectoid reaction ($\alpha \rightarrow \beta + \gamma$) takes place with a conversion temperature at 890°C. A HF-HNO₃-glycerin etch showed a single-phase homogeneous structure of an α -solid solution with alloys containing up to 9 at. % Sn. The amount of a second γ -phase increases with increasing tin content until a single-phase structure of a γ -solid solution of the compound Ti₃Sn is noted with alloys containing 23 to 25 at. % Sn. Alloys containing 8 to 22.5 at. % Sn undergo a peritectoid reaction, at a temperature of 890°C as shown by thermal analyses and by microstructural analyses of samples quenched from above and below the conversion temperature. A study of the microstructure of quenched alloys showed that the solubility of tin in β -titanium increases from 8 at. % Sn at 890°C to 10.5 at. % Sn at 1100°C. X-ray analyses of annealed samples of alloy showed only the lines of an α -solid solution for 5, 8, 9 at. % Sn, a γ -solid solution for 23 at. % Sn (close to the composition Ti₃Sn), and an α and γ mixed phase for a 15 at. % Sn. Vickers hardness numbers were determined with a diamond pyramid at a loading of 10 kg. The hardness increases smoothly with increasing tin content to a maximum at the saturation solubility of the tin in the α - or β -solid solution. The hardness decreases smoothly with the appearance of the γ -phase until it attains a minimum at the composition of the compound Ti₃Sn. The specific electric resistance increases with an increase of tin in the solid solution of α -titanium. The rate of increase of the specific electric resistance decreases markedly with the appearance of the γ -phase. The electric resistance of an alloy with 14.3 at. % Sn was studied as a function of temperature from room temperature to 1100°C in special vacuum equipment. A sharp drop in electric resistance at 890°C confirmed the existence of a peritectoid reaction in the system Ti-Sn. (TTT)

19473

PHYSICO-CHEMICAL INTERACTION OF MANGANESE WITH NIOBIUM. E. M. Savitskii and Ch. V. Kopetskii (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 755-7(1960) Mar. (In Russian)

Microstructural, x-ray phase, and thermal analyses as well as hardness and microhardness determinations were performed on different manganese alloys containing 2.26, 2.97, 5.6, 5.64, 16.65, 17.56, and 29.85 wt. % Nb. Alloys with a small Nb content have a two-phase structure characteristic of a eutectic. With increasing Nb content, an increasing amount of an intermetallic compound is formed. With a 2.98 wt. % Nb alloy interference lines of only α -Mn with a lattice parameter $a = 8.892$ kX in the annealed state or of β -Mn with a lattice parameter $a = 6.290$ kX in the molten state can be detected by x-ray analysis. With 5.64 wt. % Nb, lines of a new phase can be detected whose intensities increase with increasing Nb content. This new phase is an intermetallic compound Mn₂Nb Laves phase with a structure of the MgZn₂ type. The lattice parameters of the Mn₂Nb phase are: $a = 4.881$ kX, $c = 7.953$ kX, $c/a = 1.629$. With increasing niobium content the hardness values fall from 900 to 950 kg/mm² for pure manganese to 650 to 700 kg/mm² for the 29.85 wt. % niobium alloy. The hardness of the intermetallic compound is less than the hardness of the α -Mn. Thermal analysis showed that additions of niobium to manganese significantly increased the temperature of the $\alpha \rightleftharpoons \beta$ transition which is shifted from 727°C for pure manganese to 800°C for the alloys. A β - γ transition takes place at 1135°C by a peritectic reaction. Fusion of a eutectic mixture of γ -Mn and Mn₂Nb occurs at 1220°C. The intermetallic compound Mn₂Nb melts at 1500°C. A phase diagram for the Mn-Nb system is constructed on the basis of these results. (TTT)

19474

PHASE DIAGRAM AND PROPERTIES OF TITANIUM-NEODYMIUM ALLOYS. E. M. Savitskii and G. S. Burkanov. *Zhur. Neorg. Khim.* 5, 751-3(1960) Mar. (In Russian)

Iodide-derived titanium (99.97%) and neodymium (99.8%) were fused in an electric arc furnace in a helium atmosphere to prepare nine alloys with a neodymium content of 0 to 10%. Smelted and forged samples were annealed in evacuated quartz ampoules for 25 hours at 1000°C and 100 hours at 850°C. Samples of alloys were quenched in water from temperatures of 600, 800, 850, 890, 920, 1000, and 1100°C to determine the state of the system at higher temperatures. Microscopic analyses of phases showed that addition of neodymium stabilizes the α -phase. The microhardness of the γ phase is about 70 kg/mm². Apparently, no intermetallic compounds are formed in the Ti-Nd system. The limiting saturation of the α -solid solution at 600°C is 1.8 wt. % Nd, as determined from microhardness values on quenched samples of variable neodymium composition. The solubility of neodymium is somewhat greater than the solubility of lanthanum and cerium in α -titanium because of the lanthanide contraction. Brinell hardness values, yield strength, elongation, and reduction in cross-section area were also determined at room temperature. Neodymium is more effective than lanthanum or cerium in increasing the hardness and strength of titanium. Small additions of Nd(0.5%) decrease the plasticity slightly. The addition of 1.2 wt. % Ce increases the yield strength of titanium from 32 to 38 to 40 kg/mm², while the same amount of neodymium increases the yield strength to 48 to 50 kg/mm². The strength of Ti-Nd alloys continues to increase even with the appearance of a second phase in the alloy, while in the Ti-La and Ti-Ce systems a decrease in strength and a sharp drop in plasticity occurs upon the appearance of a second phase. The solubility of neodymium in α -titanium varies considerably with temperature. Hence, a noticeable aging effect can be expected, but this must be confirmed by experiment. (TTT)

19475

PHASE DIAGRAM OF CHROMIUM-LANTHANUM ALLOYS. E. M. Savitskii, V. F. Terekhova, and A. V. Kholopov (Baikov Inst. Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 754-5(1960) Mar. (In Russian)

Electrolytic chromium purified in hydrogen and lanthanum metal (99%) were fused in an electric arc furnace in an atmosphere of helium to prepare alloys with up to 30% lanthanum. The average loss of lanthanum during fusion was less than 25% of the lanthanum introduced. Annealing of the alloys at 1200°C for 100 hours led to a growth of grain size of chromium. The saturation solubility of lanthanum in solid chromium did not exceed 1.5 wt. % lanthanum after annealing. The 10, 15, 20, and 30 wt. % lanthanum alloys showed that immiscibility and segregation was taking place. Solubility determinations were made by quenching samples from various temperatures. Thermal analyses showed that the $\alpha + \gamma \rightarrow \beta + \gamma$ transformation took place at 705°C. The melting point of the second phase, rich in lanthanum, was found to be $865 \pm 5^\circ\text{C}$. No intermetallic compounds of lanthanum and chromium could be found. (TTT)

19476

DETERMINATION OF DIFFERENTIAL THERMOELECTROMOTIVE FORCE AT HIGH TEMPERATURES. BASIC DIAGRAM. V. S. Kutsev, B. F. Ormont, Yu. N. Chizhikov, and R. N. Morzheedova (Karpov Inst. of Physics and Chem-

istry, USSR). *Zhur. Neorg. Khim.* **5**, 891-3(1960) Apr. (In Russian)

Ordinarily the differential thermoelectromotive force (E) of a sample held at a difference in temperature $T_1 - T_2$ is measured by welding the platinum arms of a Pt-PtRh thermocouple to the metallic sample to assure good contact. This method is unsuitable for ceramic materials or at temperatures $>1200^\circ\text{C}$ where reaction of platinum with the sample can occur. These difficulties can be avoided by introducing on each side of the sample small intermediate conductors which are made of a material that will not react with platinum or the sample at 800°C , and has as low a thermal e.m.f. as possible. The value of E for the circuit is then equal to the algebraic sum of the individual thermal e.m.f. The intermediate conductors are held at the same temperature $T_1 = T_2 < 800^\circ\text{C}$. On substituting a standard made of the same material as the intermediate conductor into the circuit in place of the sample being investigated, the value of E should be zero. Thus, the thermoelectric properties of various materials can be compared at $>1200^\circ\text{C}$ with reference to a standard material which can be ZrN for various nitrides or a refractory metal such as molybdenum or tungsten. Similarly, a standard material can be selected for refractory silicides. Measurements were made up to 1900°K on tungsten carbide and silicon carbide on samples 15 mm long and 4 mm in diameter. The over-all error of measuring the differential thermal e.m.f. was $<20\%$. The method is considered a micro method, and temperatures even greater than 1600°C can be used. (TTT)

19477

PHASE DIAGRAM OF THE SYSTEM TiFe-V. Ch'ing-hua Pi and I. I. Kornilov. *Zhur. Neorg. Khim.* **5**, 902-7(1960) Apr. (In Russian)

Sintered mixtures of vanadium and the compound TiFe with 3, 5, 7, 10, 15, 20, 25, 28, 30, 32, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, and 90 wt.% V were fused in an electric arc furnace, first under vacuum and then in an argon atmosphere. Thermal analysis indicates the formation of the ternary metallic compound (TiFe)V at 1390°C by way of a peritectic reaction between a solid solution (with vanadium as a base) and a liquid phase. The compound (TiFe)V forms a solid solution designated as a γ phase. It has a hexagonal structure similar to TiFe_2 (MgZn_2 type) whose lattice parameters are: $a = 4.88 \text{ \AA}$, $c = 7.96 \text{ \AA}$, and $c/a = 1.63$. Its hardness is high, being equal to 800 Hv. The second (lower) part of the solidus curve at 1365°C indicated a eutectic crystallization of σ and γ phases on a base of TiFe and (TiFe)V, respectively. In the system TiFe-V there are three homogeneous solid solutions (δ , γ , and β) on a base of TiFe, (TiFe)V, and V, respectively, and two regions with two phases ($\delta + \gamma$ and $\gamma + \beta$). The solubility of (TiFe)V in vanadium increases with temperature, while the solubility of TiFe or V in the γ solid solution hardly changes with temperature. The hardness of alloys containing 15 to 70 wt.% V remains almost constant irrespective of thermal treatment. At first the hardness increases up to 20 wt.% V to formation of the compound (TiFe)V. Then, from 25 to 33 wt.% V, the region of the γ phase, the hardness remains at a maximum and gradually decreases with increasing vanadium content. Establishing the nature of the phases in the quasi-binary system TiFe-V is of value in studying the effect of the compound (TiFe)V on the properties of vanadium and in investigating the phase diagram of the ternary system Ti-TiFe-V. (TTT)

19478

SOLUBILITY STUDY IN THE SYSTEM $\text{Y}(\text{NO}_3)_3 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}$ AT 25 AND 50°C . F. M. Perel'man, A. Ya. Zvorykin,

and G. A. Demina (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* **5**, 960-3(1960) Apr. (In Russian)

Although fractional crystallization of the lanthanide double nitrates $\text{R}(\text{NO}_3)_3 \cdot 2\text{NH}_4\text{NO}_3 \cdot 4\text{H}_2\text{O}$ have long been used to separate the cerium group of the rare earths from the yttrium group, a detailed study of these systems was not yet undertaken. It was established that at 50°C an anhydrous double nitrate of the composition $\text{Y}(\text{NO}_3)_3 \cdot 2\text{NH}_4\text{NO}_3$ is formed at concentrations of NH_4NO_3 from 18 to 44% and of $\text{Y}(\text{NO}_3)_3$ from 48 to 66%. This double nitrate salt could not be obtained at 25°C because of the extreme viscosity of the solutions at this temperature. The solubility of the double nitrate salt of yttrium in water at 50°C is equal to 88 wt.%. Yttrium nitrate crystallizes as the tetrahydrate $\text{Y}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$ in the presence of ammonium nitrate, both at 25 and at 50°C . (TTT)

19479

VISCOSITY OF MELTS OF THE BINARY SYSTEMS NaF-MgF_2 AND $\text{Na}_3\text{AlF}_6\text{-NaMgF}_3$. M. M. Vetyukov and V. Ya. Nikitin (Kalinin Leningrad Polytechnic Inst.). *Zhur. Priklad. Khim.* **32**, 2793-6(1959) Dec. (In Russian)

The viscosity of binary melts of the systems NaF-MgF_2 and $\text{Na}_3\text{AlF}_6\text{-NaMgF}_3$ was determined by means of a torsion-type viscosimeter. In the first system the viscosity increased as the MgF_2 content was raised from 0 to 80%. Beyond the chemical compound NaMgF_3 , the isotherms assumed an S shaped aspect, characteristic for systems in which the components interact chemically. The melts are of ionic nature. Complex formation was shown by the presence of a maximum in the activation energy curve near the equimolar composition. The isotherms of the second system pointed to the absence of interaction between components. From the viewpoint of the electrolysis of aluminum it is of interest to note that MgF_2 added to the melt up to 6% is completely taken up into the compound NaMgF_3 , thus reducing the activity of the Mg^{2+} ions, shifting the potential to the electronegative side. (TTT)

19480

SOLUBILITY OF ALUMINA IN FELDSPAR MELTS. V. Z. Petrova and A. I. Avgustinik. *Zhur. Priklad. Khim.* **32**, 2788-91(1959) Dec. (In Russian)

The effect of alumina dissolved in feldspar on the microhardness, brittleness, and elastic properties of the vitreous phase was investigated. In view of the great chemical stability of corundum, it dissolves very slowly in the melt; at 1600°C only about 20% of this material will go into solution. Prolonged soaking helped the dissolution process. X-ray-diffraction tests did not reveal the presence of mullite even at high Al_2O_3 contents. The microhardness of the vitreous phase was considerably increased by the dissolution of corundum. (TTT)

19481

SOLUBILITY OF HYDROGEN IN STEELS AT ELEVATED TEMPERATURES AND PRESSURES. Yu. I. Archakov and V. P. Teodorovich. *Zhur. Priklad. Khim.* **32**, 2667-73(1959) Dec. (In Russian)

The effect of additives, such as Cr, V, and Ti, on the solubility of H_2 in carbon steels containing 0.2% C was determined at elevated temperatures and pressures and compared with carbon steel No. 20. Annealed austenitic and ferritic-martensitic steels were also studied in order to establish the effect of the crystalline structure on the solubility of H_2 . The measurements were performed by saturating the steel at high temperatures and pressures with H_2 , then quenching the specimen to room temperature while keeping it under pressure, thus minimizing losses

due to diffusion. The tests were made in an autoclave at pressures up to 1000 kg/cm² at about 500°C. The H₂ was released by heating the specimens subsequently in vacuum. Addition of 0.48% V increased the solubility of the gas because of the increase of lattice parameters caused by the formation of solid solutions. Cr in amounts up to 13% increased the solubility only slightly, as the atomic diameters of Fe and Cr are within 1% of each other. Austenitic steels took up five times as much H₂ as carbon steels and about 7 to 8 times as much as ferritic-martensitic ones. The amount of H₂ dissolved is proportional to the square root of the pressure. (TTT)

19482

CHEMICAL STABILITY AND HYDROLYTIC DECOMPOSITION OF THE DIBORIDES OF CERTAIN TRANSITION METALS INTERACTING WITH ACIDS. L. Ya. Markovskii and G. V. Kaputovskaya. *Zhur. Priklad. Khim.* **33**, 569-77 (1960) Mar. (In Russian)

The mechanism of the interaction of Zr, Ti, and Cr diborides with HCl, H₂SO₄, and HNO₃ was investigated and compared with acid resistant compounds such as B₄C and MoSi₂. The test specimens were prepared by hot pressing, in graphite molds at 1800°C and 100 kg/cm², powders which were prepared (a.) by reducing metal and boric oxide mixtures with carbon; (b.) by vacuum reduction with boron carbide; and (c.) by electrolysis of molten salt mixtures. Test showed that the electrolytically prepared ZrB₂ and TiB₂ specimens are soluble in HCl but to a much lesser degree than the corresponding samples prepared by the other two methods. Addition of Si lowered the acid resistance of all the substances studied. CrB₂ was decomposed by cold, ZrB₂ by slightly heated HCl. Hydrolysis of these borides yielded H₂, boron hydrides, and boric oxide. The formation of suboxides reduced the amount of H₂ liberated during the reaction, -specifically, TiB₂ yielded less hydrogen than calculated from the equations stipulated for the reaction. The various higher boron hydrides such as B₂H₆ and B₄H₁₀ passed through a primary stage of BH₃. The hydrolytic decomposition and the polymerization of the reaction products might be influenced by an as yet unknown catalyst. (TTT)

19483

PROPERTIES OF COMPACTS PREPARED WITH TITANIUM BORIDE AND THE DOUBLE BORIDE OF TITANIUM AND CHROMIUM WITH BORON CARBIDE. K. I. Portnoi, G. V. Samsonov, and K. I. Frolova. *Zhur. Priklad. Khim.* **33**, 577-82(1960) Mar. (In Russian)

In order to improve the heat stability of B₄C (a hard, erosion resistant material), an attempt was made to combine it with other hard materials by grinding the components and forming a eutectic crystal structure. High-melting, oxidation resistant TiB₂ and the double boride (Ti,Cr)B₂ were ground and hot-pressed together with B₄C at temperatures up to 2400°C; and the microhardness, phase structure, and oxidation resistance were determined. X-ray diffraction studies revealed the mutual solubility of the components. Oxidation resistance testing in air at 1200°C for 100 hours showed a reduced oxidation for mixtures containing 20 to 70% B₄C. Best results were obtained with compacts having equivalent volume ratios of the components; a protective oxide layer is formed and grain growth is inhibited. Similar results were obtained with the double boride (Ti,Cr)B₂. Although complex borides had a higher oxidation resistance, they are recommended only for short-term applications at elevated temperatures in air. (TTT)

19484

DETERMINATION OF THE ELECTRICAL RESISTIVITY

OF METALS DURING ELECTROLYTIC HYDROGEN ABSORPTION. V. V. Kuznetsov and V. A. Frolov (Gorkii Perm State Univ., USSR). *Zhur. Priklad. Khim.* **33**, 628-32(1960) Mar. (In Russian)

In order to determine the degree of cathodic hydrogenation of metals, the resistivity changes occurring during electrolysis were measured, using the resistivity of the metal at 20°C as a reference for obtaining the temperature coefficient of the process. Previously vacuum-annealed stainless steel and Monel specimens were subjected to cathodic polarization in 0.1 N H₂SO₄ solutions at average current densities of 50 ma/cm². It was found that even very small amounts of H₂ absorbed by the metal increases the resistivity noticeably. The change in resistivity is caused by the formation of a solid solution between the metal and H₂ and by the separation of molecular H₂ in the voids. The effect of these two processes on the resistivity change appeared to be nearly identical. (TTT)

19485

KINETICS OF DESCALING OF STAINLESS STEEL NO. 1X18H9T IN NITRIC ACID SOLUTIONS. A. I. Matantsev. *Zhur. Priklad. Khim.* **33**, 674-85(1960) Mar. (In Russian)

In order to study the problem systematically, the kinetics of the descaling process of stainless steel No. 1X18H9T was investigated. Nitric acid solutions ranging from 0.4 to 40% and cold-rolled, 0.5 to 0.7 mm thick specimens which were previously heated to 1110 to 1120°C were used. Gas-volumetric, potentiometric, and polarographic measurements confirmed the original gravimetric results which indicated that the descaling process follows the laws of chemical and electrochemical kinetics. The passivation phenomena observed were similar to adsorption isotherms. For each temperature an optimum concentration of HNO₃ was found, at which the descaling velocity reaches a maximum. With increasing temperatures this maximum shifts toward the lower concentrations of the acid. Depending on the prevalent conditions, the descaling is diffusion-controlled or takes the form of an electrode reaction. The effect of the electric contact between the metal and the scale appeared to be insignificant. The metallic portion of the scale behaved like metallic iron in the same solutions. These results should help to control the descaling process. (TTT)

19486

A METHOD FOR IMPROVING THE ANTICORROSION AND THE ANTIFRICTION PROPERTIES OF PROTECTED AND UNPROTECTED SURFACES OF PRODUCTS. A. F. Kurtikov. *Zhur. Priklad. Khim.* **33**, 685-90(1960) Mar. (In Russian)

Treatment of coated and uncoated metals by oxidizing and phosphatizing methods resulted in marked passivation of the surface and improved its adherence, anticorrosion, and antifriction properties. A reagent containing ZnO and orthophosphoric acid was found to be especially useful for the treatment of springs and stressed metallic specimens, as the danger of crack formation is thus avoided. Black-phosphatizing and oxide-phosphatizing treatment also yielded an antifriction layer. The new method protected the test specimens against oxidation under atmospheric conditions for periods ranging up to 20 days, while control specimens protected by older treatments started to show rust spots after only 4 days. (TTT)

19487

CERTAIN FEATURES OF TITANIUM BORIDE BY THE HIGH TEMPERATURE VACUUM METHOD. V. F. Funke, S. I. Yudkovskii, and G. V. Samsonov (All-Union Research Inst. of Solid Solutions, USSR). *Zhur. Priklad. Khim.* **33**, 831-5(1960) Apr. (In Russian)

The effect of batch size and purity of raw materials on the yield and the properties of TiB_2 , prepared by heating in vacuum a mixture of TiO_2 , B_4C , and charcoal, was investigated. It was found that the temperature must be increased to $1700^\circ C$ as the batch size is increased, while keeping the pressure at 1.10^{-4} mm of Hg. Using the stoichiometric ratio of C : B = 0.276, the reaction is not completed and the end product will contain an insoluble residue. Impurities in the starting materials, such as Si, Fe, Al, and Mn are removed during soaking at high temperature in vacuum and do not influence the purity of the end product as was shown by spectrographic analysis; on the other hand, Mg and Co are harder to remove. Results show that technical TiO_2 and B_4C may be used for preparing pure TiB_2 . (TTT)

19488

EFFECT OF THE CATHODIC POLARIZATION OF TANTALUM ON ITS ELECTRICAL CONDUCTIVITY. Kh. L. Tseitlin, E. K. Revazov, and V. A. Strunkin (Voroshilov Inst. of Organic Intermediates and Dye Products, USSR). *Zhur. Priklad. Khim.* 33, 850-4(1960) Apr. (In Russian)

It was found previously that cathodic polarization of Ta is accompanied by hydrogen up-take, causing ultimately cracking. Determination of the change of the electrical resistance presents a convenient method for measuring the amount of H_2 absorbed during the polarization process, allowing a prediction of the level of undesirable mechanical properties. Ta sheets containing about 1% Nb were used as cathode, a graphite rod as anode, and a 20% HCl solution as electrolyte in an electrolytic apparatus using current densities ranging from 0.1 to 10 amp/ m^2 . The resistance of Ta was found to increase directly with the amount of absorbed H_2 . Increasing the cathode thickness from 1 to 5 mm required considerably longer periods of time to saturate it completely. Cracking of the metal is imminent when its specific resistance increases by 20 to 40% at 20° and by 90 to 110% at $60^\circ C$ over its original value. (TTT)

19489

TEMPERATURE DEPENDENCE OF ION DIELECTRIC PERMITTIVITY IN A WIDE RANGE OF TEMPERATURES. L. A. Aleksandrov, N. P. Bogoroditskiĭ, K. E. Lisker, and I. D. Fridberg (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 699-704(1960) June. (In Russian)

The permittivity of ion dielectrics as a function of temperature was studied with pure crystalline phases and mixtures of $BaO-Al_2O_3-2SiO_2$, $BeO-Al_2O_3$, $Mg_2TiO_4-Zn_2TiO_4$, $CaTiO_3-NiTiO_3$, $CaZrO_3$, $SrZrO_3$, $BaZrO_3$, $CaSnO_3-BaSnO_3$, $CaO, MgO, TiO_2, ZrO_2, ZrTiO_4, BaO-4TiO_2, Nb_2O_5-4ZrO_2, BaO-TiO_2-SiO_2$, and some compound of $BaO-TiO_3$, $CaO-ZrO_2$, ZrO_2-TiO_2 , and $CaZrO_3-BaZrO_3$ in the range 400 to $1600^\circ C$. (R.V.J.)

19490

Battelle Memorial Inst., Columbus, Ohio.
REACTOR CORE MATERIALS. Technical Progress Review, Vol. 3, No. 2. R. W. Dayton, E. M. Simons, and R. W. Endebrock. 1960. 59p. \$0.55(GPO)(domestic), \$0.70(GPO)(foreign).

Fuel and Fertile Materials. A review of developments in U, alpha-phase U alloys, epsilon-phase U alloys, gamma-phase U alloys, dilute U alloys, Pu and Pu alloys, Th and Th alloys, dispersion fuel elements, refractory fuel and fertile materials, basic studies of irradiation effects in fuel materials, mechanism of corrosion of fuel alloys, and metal-water reactions is reported. Moderator Materials. Developments in graphite, Be metal and alloys, Be compounds, and solid hydrides are reported. Nuclear Poisons. Research and development are reported in dispersion

poison materials and metallic poison materials. Cladding and Structural Materials. Research on corrosion, Zr-water reactions, radiation effects in nonfuel materials, selected mechanical properties of cladding and structural materials, and selected metallurgical aspects of cladding and structural materials is presented. Special Fabrication Techniques. Developments are reported in melting, fabrication, cladding, welding and brazing, explosion forming, and nondestructive testing. (W.L.H.)

19491

IMPROVEMENTS IN OR RELATING TO ALLOYS OF URANIUM. Peter Charles Leslie Pfeil (to United Kingdom Atomic Energy Authority). British Patent 836,692. June 9, 1960.

Uranium alloys which have superior mechanical properties at elevated temperatures are presented. The alloys described are: U-10 to 27% Mo and U-10 to 27% Mo-2 to 6% Ta or W. (W.L.H.)

19492

A METHOD FOR THE PRODUCTION OF METALLIC URANIUM OR URANIUM ALLOYS. (to Centro Informazioni Studi Esperienze). British Patent 837,042. June 9, 1960.

A process is described for the production of U metal or alloys by the thermal reduction of a U double fluoride. The U or U alloy is produced by reducing a U double fluoride by means of an alkali metal, alkaline earth metal, or Al and heating the mixture to a temperature between $110^\circ C$ and its melting point to increase its density. After heating, the mixture is ground to a suitable grain size, mixed with the reducing element, and heated in a sealed vessel to cause the reduction to take place. (W.L.H.)

Radiation Effects

19493 AD-231899

Philco Corp. Lansdale Tube Co. Div., Penna.
NUCLEAR RADIATION RESISTANT POWER TRANSISTORS. Quarterly Progress Report No. 2 [for] August 15 to November 15, 1959. G. F. Watson. 31p. Contract DA-36-039-SC-78307. (RI09-B).

The calibration of the MIT nuclear reactor was verified. It was demonstrated that exposure of surface barrier transistors in core tube 3GV6 at a power level of 1 megawatt for periods of 1.8 and 18 min will provide accumulated dosages of 10^{13} and 10^{14} nvt, respectively. The haziness apparent at the bottom of etched pits was eliminated by the use of larger diameter jets. The haze, which is believed to contribute to excessive leakage current, was eliminated without adversely affecting pit geometry. A cabinet-model precision plater was constructed and put into operation. Emitter electrodes 80 mils diam and collector electrodes 100 mils diam were plated with this system. Because of the success achieved with jet plating, formation of electrodes by evaporation will no longer be used. Considerable progress was made in device assembly techniques. A brush plating technique was developed for gold plating only the top of the stem. Consistently good blank-to-tab soldering was obtained through the use of nickel tabs and a modified soldering fixture. Some difficulty was experienced in soldering the collector electrode to the stem pedestal. A new stem mounting fixture is presently being evaluated. Un-mounted electrical samples were constructed. (auth)

19494 AD-232188

Stevens Inst. of Tech., Hoboken, N. J.
UNCLASSIFIED LITERATURE SURVEY ON THE EFFECTS OF NUCLEAR RADIATION TO ELECTRON TUBE MATERIALS. Quarterly Report No. 10 for September 1, 1959 to

November 30, 1959. E. R. Johnson. 67p. Project No. 3-99-13-000. Contract DA 36-039-SC-73146.

Preliminary information on radiation damage to ceramic and sub-miniature type tubes is presented. Based on comparison of specification limits after exposure to mixed pile radiation, no out-of-specification tubes were found. No deleterious effects were observed after 10^{16} nvt. Results of pre- and post-irradiation testing are tabulated. In addition to experimental work a review of classified and unclassified literature on the effects of radiation on electron tube materials was conducted. (For preceding period see AD-228813.) (J.R.D.)

19495 AERE-R-3339

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

IRRADIATION STUDIES ON ANHYDRIDE CURED EPOXY RESIN. I. D. Aitken, K. Ralph, and R. Sheldon. May 1960. 8p. BIS.

Results of pile, gamma, and electron irradiation on the physical properties of anhydride cured epoxy resin are presented. (auth)

19496 APDA-130

Atomic Power Development Associates, Inc., Detroit. IRRADIATION TESTING OF ENRICO FERMI PROTOTYPE FUEL PINS IN THE CP-5, 1957-1959. M. A. Silliman, A. A. Shoudy, W. G. Blessing, and P. R. Huebotter. Apr. 1960. 56p. OTS.

A program was conducted to proof-test zirconium-clad molybdenum-uranium alloy fuel pins and to verify the predicted allowable burnup of this alloy based on previous MTR capsule irradiation tests. Tests of three full-length pins were completed with burnups ranging from 0.3 to 1.0 at.%. These results verified predicted high-temperature allowable burnups and showed that under certain conditions excessive swelling could occur at low temperatures. Test procedures are described, and photographs showing microstructures are included along with various experimental data. (J.R.D.)

19497 BMI-1446

Battelle Memorial Inst., Columbus, Ohio. EXPERIMENTS TO DETERMINE THE RADIATION STABILITY OF UN DISPERSIONS IN STAINLESS STEEL. John E. Gates, David G. Freas, James H. Saling, and Ronald F. Dickerson. June 14, 1960. 31p. Contract W-7405-eng-92. OTS.

A controlled radiation experiment was performed to determine the stability of fuel containing 28 wt.% UN dispersed in and clad with Type 318 stainless steel as compared with fuel containing 30 wt.% UO_2 dispersed in the same material. The specimens were prepared by hot rolling the fuel coupons in Type 318 stainless steel using the picture-frame technique for initial bonding and reduction. Final dimensions were obtained by cold rolling. A special radiation capsule was designed which contained heat control and enough thermocouples to ensure a good continuous-temperature history throughout the test. This capsule and the method by which the specimens were loaded are discussed in some detail. Because of the capsule instrumentation, the known MTR position into which the capsule was placed, and the dosimeters placed in the capsule it was possible to obtain a complete flux and temperature history of the capsule during the irradiation. When it was estimated that the specimen burnup was about 7.2 at.% of uranium-235 the capsule was removed from the reactor and returned to the Battelle Hot-Cell Facility. The post-irradiation examination which consisted of fission-gas

analysis, density and dimensional determinations, radiochemical and isotropic burnup analysis, and metallography is discussed completely in the report. The results of the various phases of the experiment are discussed and conclusions are drawn on the basis of an integrated evaluation. These results indicate that the UN dispersions withstood irradiation at temperatures of 1500 to 2000°F and at burnups of 3.5 to 5.0 at.% of the uranium-235 at least as well as the UO_2 dispersions. These conclusions indicate the potential of UN as a high-temperature fuel, however, it is also obvious that many additional radiation experiments are required. (auth)

19498 CF-55-4-162

Oak Ridge National Lab., Tenn.

THORIUM OXIDE SLUGS. R. M. Carroll. Apr. 28, 1955. Decl. July 2, 1957. 9p. OTS.

Aluminum-jacketed thorium oxide slugs were irradiated in the LITR. After irradiation dimensional measurements were made, an increase in diameter and length was noted; however, measuring apparatus limitations render the observations uncertain. Neutron dosages were recorded by cobalt monitors. The slugs were found to be cracked when the jackets were removed. (J.R.D.)

19499 CRMet-922

Atomic Energy of Canada Ltd., Chalk River, Ont. THE ANNEALING OF IRRADIATION DAMAGE IN ZIRCALOY-2 AND THE EFFECT OF HIGH TEMPERATURE IRRADIATION ON THE TENSILE PROPERTIES OF ZIRCALOY-2. L. M. Howe. Apr. 1960. 35p. (AECL-1024). AECL.

Tensile specimens of annealed and cold-worked Zircaloy-2 were irradiated at 380°C with 9.5×10^{19} n/cm² and tested at room temperature. Annealed samples of Zircaloy-2, irradiated at 280°C with 7.7×10^{19} n/cm² and at 50°C with 9.1×10^{19} n/cm², were given isothermal and isochronal post-irradiation anneals and then tested at room temperature. The annealed and cold-worked specimens irradiated at 380°C exhibited only a small amount of radiation damage in contrast to specimens irradiated at or below 280°C which experienced considerable irradiation hardening. Results on the cold-worked material irradiated at 380°C indicated that the amount of normal thermal recovery of cold-work which occurred during the irradiation was virtually identical to that which occurred during an out-pile heat treatment at 380°C for the same length of time. An analysis of the post-irradiation annealing data for the 50 and 280°C irradiations revealed that in both cases the radiation damage anneals out in the range 250 to 400°C and is characterized by a single activation energy of approximately 2 eV throughout this range. (auth)

19500 DOFL-TR-792

Diamond Ordnance Fuze Labs., Washington, D. C. RADIATION DAMAGE OF DC-TO-DC POWER CONVERTERS. Paul A. Trimmer and Louis DeLuca. Jan. 29, 1960. 13p. DA Project 5N98-09-003. (AD-232333). OTS.

Semiconductor devices normally used in the d-c converter of the T3022E1 fuze system were exposed to neutron radiation up to 0.7×10^{15} nvt. Measurements of their characteristics were made before and after irradiation. The current gain (β) of the transistors was reduced by the neutron radiation to the extent that they would not function properly in the circuit. This was corrected by adding a biasing resistor to the base circuit of one of the transistors. The results of this study indicate that this unit will then operate reliably after being exposed to neutron radiation up to 0.7×10^{15} nvt. (auth)

19501 DOFL-TR-832

Diamond Ordnance Fuze Labs., Washington, D. C.
GAMMA RAY DOSE RATES DUE TO CAPTURE OF THERMAL NEUTRONS IN PURE MATERIALS, ALLOYS, AND GLASSES. Herman Schulman. May 4, 1960. 59p. DA Project 5-N98-09-003. OTS.

A method of calculating the dose rate, in roentgens per hour, due to gamma rays released during the radioactive decay of the capture products of thermal neutrons impinging upon pure materials is described. The method is specialized to the case of a pulsed-reactor source of thermal neutrons. Results for a time-integrated thermal flux of 10^{12} neutrons per square centimeter are tabulated for a point of observation one meter from the activated material, which is treated as a point source of gammas. Use is made of these results in calculating the "specific dose rate" (roentgens per hour per gram) for several activated alloys and glasses under similar conditions. A sample calculation sheet for alloys not included is appended. (auth)

19502 DP-185

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

SHEARING IRRADIATED URANIUM PLATES. W. Scott Delicate, Edmund J. Osterman, and Carl W. Zeh. Nov. 1956. Decl. May 4, 1960. 21p. Contract AT(07-2)-1. OTS.

Natural U plates that were irradiated to 600 and 1500 Mwd/t were cut under water by a guillotine-type shear. Irradiation reduced the force required for shearing to 50% of that required for unirradiated U. Measurements were made of radioactivity released to treated and untreated water in which the cut sections were stored. (auth)

19503 DP-224

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

SHEARING IRRADIATED URANIUM PLATES. PART II. Roland B. Olcott. July 1957. Decl. May 4, 1960. 13p. Contract AT(07-2)-1. OTS.

Radioactive contamination was confined and controlled in an isolation tank when irradiated plates of natural U were cut under water. (auth)

19504 HW-40288

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUMMARY OF HAPO RESEARCH AND DEVELOPMENT PROGRAM ON CERAMIC FUEL MATERIALS. M. J. Sanderson. Dec. 12, 1955. Decl. May 6, 1960. 4p. Contract [W-31-109-Eng-52]. OTS.

Specimens of UO_2 fuel materials were irradiated in MTR, and measurements indicated no dimension changes. Equipment for further examination is unavailable. (T.R.H.)

19505 HW-42652

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EXAMINATION OF IRRADIATED URANIUM-MAGNESIUM MATRIX FUEL MATERIAL. Interim Report No. 2. W. S. Kelly. May 7, 1956. Decl. May 4, 1960. 4p. Contract [W-31-109-Eng-52]. OTS.

Uranium-magnesium fuel materials were irradiated at 1000 to 20,000 Mwd/ton, after which bend tests were performed to obtain information on physical property changes. A discussion of results is included, and data from the bend tests are presented graphically. (J.R.D.)

19506 HW-64814

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

IN-REACTOR CREEP MEASUREMENTS ON ZIRCALOY-2. L. J. Chockie. Apr. 11, 1960. 7p. OTS.

The irradiation performance of a prototype creep capsule, capable of making continuous measurements of the creep of an annealed Zircaloy-2 specimen, was found to be satisfactory. Annealed specimens of Zircaloy-2 exhibited in- and ex-reactor creep rates of 1.69×10^{-6} ($\pm 0.52 \times 10^{-6}$) and 1.5×10^{-7} ($\pm 0.1 \times 10^{-7}$) in./in./hr, respectively, at 500°F and at a stress of 30,000 psi. (C.J.G.)

19507 MND-2266

Martin Co. Nuclear Div., Baltimore.

GAMMA RADIATION EFFECTS ON HULL SEALANTS.

Final Report. Jan. 1960. 43p. Contract NOa(s) 56-910-c.

Ten sealants presently in use on seaplanes of the U. S. Navy and on the Princess flying boats of the British Navy were evaluated. Irradiation was completed using a 3000-curie Co^{60} source. The source, contained in 78 pencils, was placed in a cylindrical array about an air-tight canister and provided a dose rate of between 0.19 and 0.16 megarep per hour over the study period. Dynamic test pressure discs, sealed with the sealant in question, and the static test samples were prepared. Tensile and peel strengths, elongation, hardness, and weight change properties of each sealant, at three accumulated doses up to 200 megarep, were evaluated. Corrosion effects and jet fuel absorption properties were also studied. The 10 sealants covered were EC-801, PR-1422, EC-1602, Silastic RTV-501, PR-1321, marine glue, barium chromate, Bostik 1790, Bostik 1752, and Bostik 1751. All sealants showed a degradation of mechanical properties due to radiation damage. All the sealants with the exception of EC-801 and EC-1602 held up satisfactorily under the dynamic tests and could be used in radiation fields if they were used between metal surfaces and if they are not subjected to large structural loads. Three sealants, Bostik 1790, PR-1321, and PR-1422, exhibited only moderate changes in the mechanical properties and could be used as sealants in radiation fields where the useful lifetime accumulated dose would not exceed 50 to 75 megarep. (auth)

19508 NAA-SR-Memo-4333

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

TRANSIENT HEATING OF UC FUEL ELEMENTS IN THE KEWB FACILITY. E. L. Gardner and S. G. Barnes. Sept. 1, 1959. 22p. OTS.

The feasibility of using the KEWB reactor as a pulsed neutron radiation source for use in studies of fuel element transient heating was studied. UC fuel rod samples were heated in the reactor. It was found that flux distribution in fuel samples could be mapped and thermal conductivity measurements for UC could be made by using fast response thermocouples distributed radially in the sample. (J.R.D.)

19509 NP-8825

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

MONTHLY ACCESSION LIST NO. 36 [ON RADIATION EFFECTS DATA]. June 15, 1960. 19p. Project No. 2133. Contract AF33(616)-7375.

A bibliography is given of 47 references placed in the files of the Radiation Effects Information Center (REIC) from May 1 to May 31, 1960, together with a list of REIC publications. The references cover radiation effects on electrical systems, a wide variety of inorganic and organic chemicals, and metals and include dosimeters and space radiation as well. (D.L.C.)

19510 NP-8841

Lockheed Nuclear Products, Marietta, Ga.

ANALYTICAL ANALOG STUDY OF SOME RADIATION EFFECTS ON AN ELECTRO-HYDRAULIC SERVO TEST

LOOP. E. D. McCalla and J. W. Benson. June 1960. 75p. Contract AF33(600)-32055. (NR-91).

An analytical study was made of radiation effects on an electro-hydraulic system by using the analog computer. Because of the nonlinearities involved in the system, the various aspects of the study were carefully considered. The system and its component parts are described. The various methods of analysis are discussed, and the most suitable method for this system is selected. The significant parameters of the system were determined, and the appropriate way to express these parameters in the analysis of the system was investigated. After a study of this information, an analog of the system was developed. Radiation damage was simulated on the analog, and data of system performance, using frequency response tests, were tabulated. (auth)

19511 NP-8846

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE EFFECT OF REACTOR FAST NEUTRONS ON SEMI-CONDUCTORS. H. Rzewuski. 1960. 8p.

An outline of investigations of reactor fast neutron bombardment is presented. (auth)

19512 NP-8854

Stevens Inst. of Tech., Hoboken, N. J.

UNCLASSIFIED LITERATURE SURVEY ON THE EFFECTS OF NUCLEAR RADIATION TO ELECTRON TUBE MATERIALS. Quarterly Report No. 12 [for] March 1, 1960 to May 31, 1960. E. R. Johnson. 20p. DA Project 3-19-01-001-01. Contract DA-36-039-SC-73146.

Current literature and advances on radiation damage to electron tubes and tube components are reviewed. Godiva and TRIGA transient measurements on triodes and thyatrons indicate that the gain of triodes was definitely affected while the operations of the thyatrons were only slightly affected by the TRIGA pulse. The current leakage across polyethylene coax cable exposed to gamma rays is directly proportional to dose. (auth)

19513 NRL-5479

Naval Research Lab., Washington, D. C.

THE EFFECT OF NEUTRON IRRADIATION ON THE CHARPY V AND DROP-WEIGHT TEST TRANSITION TEMPERATURES OF VARIOUS STEELS AND WELD METALS. J. R. Hawthorne and L. E. Steele. Mar. 3, 1960. 28p. Project Nos. RR-007-01-42-5409 and NS-021-300.

Charpy V-notch and drop-weight specimens were used to determine changes in transition temperature for various steels and weld metals irradiated in different nuclear and thermal environments to integrated fast-neutron-flux exposures to 1×10^{18} NVT (>1.0 Mev). Irradiations to integrated fast-neutron flux levels of 5×10^{18} NVT effected 40 to 100°F shifts in transition temperatures. Increasing the irradiation temperature from 200 to 575°F significantly decreased the radiation-induced damage. Transition-temperature shifts in the order of 250°F were developed for materials irradiated at temperatures less than 200°F to an integrated fast-neutron flux dosage of 1×10^{18} NVT. Post-irradiation heat treatment revealed that recovery of properties may be obtained by 650°F annealing. Comparison of Charpy V and drop-weight nil-ductility transition temperature shifts for 17 material irradiations demonstrated excellent correspondence in the evaluation of irradiation effects by these two test methods. (auth)

19514 REIC-3(2nd Add.)

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECT OF NUCLEAR RADIATION ON ELAS-

TOMERIC AND PLASTIC MATERIALS (SECOND ADDENDUM). N. J. Broadway, R. Mayer, S. Palinchak, and M. L. Zaring. Apr. 30, 1960. 135p. Project No. 2133. Contract AF33(616)-6564.

Radiation effects information on the various elastomers and plastics published during 1959 is summarized. Information reported during 1959 indicates that radiation tolerance levels of elastomers and plastics were not substantially improved over those previously reported. Radiation data were obtained for some additional polymers including polypropylene-polyethylene elastomers, polyamide MK resin, a silicone molding compound, and a polyformaldehyde resin. Radiation polymerization and radiation vulcanization are included in this second addendum report only if the data have a bearing on radiation effects on polymers. (M.C.G.)

19515 REIC-4(2nd Add.)

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECT OF NUCLEAR RADIATION ON LUBRICANTS AND HYDRAULIC FLUIDS (SECOND ADDENDUM). S. L. Cosgrove. Mar. 15, 1960. 40p. Project No. 2133. Contract AF33(616)-6564.

Radiolysis studies indicate that alkyl aromatic hydrocarbon or alkyl aromatic ether structures probably represent an optimum compromise between physical and performance properties in conventional systems and radiation stability. Exhibiting the most promising combination of performance properties and radiation stability was Calresearch 59R-439, based on isopropyl-1, 9-diphenylnonane. Two important tentative conclusions are drawn from current work: (1) systems using conventional fluids continue to operate satisfactorily in spite of extensive radiolytic degradation; and (2) component performance with experimental radiation resistant fluids may be sufficiently different from that with conventional fluids that some hardware redesign would be necessary to realize full performance from the experimental fluids. (M.C.G.)

19516

MECHANICAL PARAMETERS AND MICROSTRUCTURE OF STRUCTURAL MATERIALS IRRADIATED BY NEUTRONS. I. M. Voronin, V. D. Dmitriev, Sh. Sh. Ibragimov, and V. S. Lyashenko. *Atomnaya Energ.* 8, 514-18(1960) June. (In Russian)

Radiation effects on the mechanical properties and microstructure of austenite, ferrite, and martensite steels and molybdenum materials during the operation of the First Atomic Power Plant are discussed. Strong drops in the plasticity of all the irradiated metals after an integral flux of $(0.9 \text{ to } 3.4) \times 10^{20}/\text{cm}^2$ at 450 to 650°C are indicated. It is also shown that the character of steel and molybdenum friability differs. (tr-auth)

19517

STRENGTH OF IRRADIATED DRAWN AND UNDRAWN NYLON. C. C. Hsiao, Y. C. Das, and A. Haynes (Univ. of Minnesota, Minneapolis). *Brit. J. Appl. Phys.* 11, 277-9 (1960) July.

The effect of reactor irradiation on the strength properties of oriented and unoriented nylon filaments was investigated. Both the ultimate strength and the elastic modulus of the undrawn sample decreased markedly to a minimum upon receiving a reactor radiation indexed by the thermal neutron component of 6×10^{17} nvt as compared with that of the drawn sample. However, at somewhat higher levels of irradiation the ultimate tensile strength and the modulus of elasticity of the undrawn nylon increased while that of the drawn nylon continued to de-

crease until they approach to nearly the same level. At still a higher dose of reactor irradiation the ultimate tensile strength of both drawn and undrawn samples dropped sharply while the modulus of elasticity increased sharply. (auth)

19518

GAMMA IRRADIATION OF LEAD SILICATE GLASS. R. S. Barker, D. A. Richardson, E. A. G. McConkey, and R. Rimmer (Pilkington Brothers, Ltd., St. Helens, Lancs, Eng.). *Nature* 187, 135-6(1960) July 9.

Results are reported from an investigation of the mechanism involved in the gamma radiation induced darkening of glass and the recovery in the dark with time. A lead silicate glass of weight percentage composition 80% PbO, 20% SiO₂ was chosen. The effect of increasing dose on optical density at different wavelengths after certain periods of fading was studied. Data are presented graphically. (C.H.)

PHYSICS

General and Miscellaneous

19519 60-GI-121

General Electric Co. General Engineering Lab., Schenectady, N. Y.

EFFECT OF CREEP ON STRESSES IN CYLINDRICAL SHELLS. H. Poritsky. June 16, 1960. 25p.

Equations were set up for studying the effect of creep on stress distribution in stressed cylindrical shells. In the original elastic stress distribution, the stress component varied linearly across any line normal to the middle surface. As creep progressed this changes to a nonlinear distribution. The equations were formulated for calculation of these stresses and the elastic and plastic strains. Results indicated that the problem of calculating the creep in the cylindrical shell led to repeated solutions of the same equations as the static equations of an elastic shell. However, these equations applied to the time rate of change of the displacement components rather than to the components themselves. Certain right-handed members appeared in these equations in the same manner as the applied external forces. These extra terms were derived from the instantaneous rates of creep and involved their integral over the thickness of the shell and the moments of these rates of change. (M.C.G.)

19520 AD-229057

National Carbon Co. Research Labs., Cleveland.
THERMOELECTRIC MATERIALS. Bi-monthly Progress Report No. 2 [for] March 28, 1959 to May 28, 1959. N. R. Thielke, comp. June 15, 1959. 20p. Contract NObs-77066.

Work was continued on the preparation of doped carbon rods. The preparation of nitrides of Sc, Y, lanthanides, and actinides is in progress. (For preceding period see AD-220537.) (W.L.H.)

19521 AD-232491

Brown Univ., Providence.

AN ELEMENTARY DISCUSSION OF DEFINITIONS OF STRESS RATE. Technical Report No. 53. William Prager. Feb. 1960. 12p. Contract Nonr-562(10).

The principal definitions of stress rate found in the literature are derived in an intuitive manner, and their suitability for the mathematical description of elastic, plastic behavior is discussed. (C.H.)

19522 AD-232789

Boeing Scientific Research Labs., Seattle.

A REVIEW OF MAGNETO-HYDRODYNAMICS. Flight

Sciences Laboratory Report No. 14. Y. A. Yoler.
Oct. 1959. 74p. (D1-82-0027).

A condensed review is presented of the basic processes involved in certain classes of engineering problems related to dynamics in situations where magnetohydrodynamic effects are important. The emphasis of the review is on aspects related to aeronautical, astronautical, and laboratory scale problems. Magnetohydrodynamic equations are examined, and discussions of channelized conducting fluid flow, plasma experiments, and relations between equilibrium configurations in magnetohydrodynamics and stationary flow fields in hydrodynamics are included. (J.R.D.)

19523 AERE-R-3271

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, England.

SOME PRELIMINARY MEASUREMENTS OF THE TRITIUM AND CARBON 14 CONTENT OF THE STRATOSPHERE OVER ENGLAND. P. Goldsmith, J. V. Jelley, F. R. Barclay, M. J. Elliott, and A. R. Osborne. Apr. 1960. 11p. BIS.

A technique is described whereby samples of water and carbon dioxide from heights of about 90,000 feet were obtained. Measurements of the tritium content of three such samples, together with the carbon 14 content of one, are presented and discussed. (auth)

19524 AFBMD-TN-60-6

Avco Corp. Avco-Everett Research Lab., Everett, Mass. RATE OF IONIZATION BEHIND SHOCK WAVES IN AIR. Research Note 170. S. C. Lin. Dec. 1959. 19p. Contracts AF04(647)-278 and DA-19-020-ORD-4862. (AD-234031).

The ionization rate was measured by using a 24-in.-diam shock tube which allows experiments to be performed at densities lower than ordinary shock tube operating density by a factor of 100. A microwave reflection probe was used in conjunction with this tube, and electron density profiles behind normal shock waves in air at density corresponding to 250,000 ft altitude and at hypersonic velocities were measured. (J.R.D.)

19525 AFCRC-TN-59-472

Stanford Research Inst., Menlo Park, Calif.

A FEASIBILITY STUDY: SUPERIMPOSED BEAMS—A TECHNIQUE FOR DETERMINING TWO-BODY REACTION CROSS SECTIONS. Scientific Report No. I. Charles J. Cook and Clarence M. Ablow. Sept. 17, 1959. 52p. SRI Project SU-2555. Contract AF19(604)-3475. (AD-226317). OTS.

Crossed molecular beams cannot be utilized to measure two-body reaction cross sections for arbitrary reactants due to difficulties of production and detection of all but a few selected species. However, a wide range of reactants can be produced in fast (kev) beams and can be individually detected. Similarly, the reaction products resulting from superimposing two fast beams could be individually detected. The feasibility of accurately determining two-body reaction cross sections by a superimposed beam technique was investigated. It is shown that the reaction rate coefficient, $\alpha(v)$, is related to an experimentally determinable function $g(w, v)$ and the measured effective coefficient $J(w)$ by the integral equation of the first kind $J(w) = \int_0^\infty \alpha(v) g(w, v) dv$, where w is the relative velocity between the superimposed beams and v is the true, particle impacting velocity. This integral equation is discussed in detail and the conditions are described under which $\alpha(v)$, and thus the reaction cross section $\sigma(v) = v^{-1}\alpha(v)$, can be

uniquely found. Techniques and apparatus are discussed that should permit $\sigma(v)$ to be determined for ion-atom interchanges. Nitrogen-oxygen reactions, such as $O^+ + N_2 \rightarrow NO^+ + N$, are of particular interest. The apparatus described must be improved before accurate studies of ion-ion recombinations or sharply resonant chemical reactions can be made. (auth)

19526 AFRCR-TN-60-108

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATIONS OF RARE-EARTH OXIDE CATHODES. Scientific Report No. 1. G. B. Gaines. Dec. 1, 1959.

13p. Project No. 4156. Contract AF19(604)-5691. OTS.

The thermionic emission from two samples each of gadolinium oxide and neodymium oxide was determined. At 1400°C, the emission from one gadolinium oxide sample was about 1 amp/cm². At the same temperature, both neodymium oxide samples exhibited an emission of about 0.1 amp/cm². The oxides were put on rhenium metal by electrophoresis. (auth)

19527 AFRCR-TN-60-125

Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

THEORETICAL AND EXPERIMENTAL RESEARCH IN THERMOELECTRICITY. Scientific Report No. 1. Dec. 31, 1959. 161p. Contract AF19(604)-4153. (AD-233257).

Theoretical and experimental investigations of thermoelectricity are reported. Selection of thermoelectric materials is discussed along with measuring equipment development, detailed material evaluations, and detailed theoretical analysis of devices and selected materials. Schematic diagrams and photographs of equipment are included. (J.R.D.)

19528 AFOSR-TN-60-527

California. Univ., Berkeley. Materials Research Lab.

SPECIFIC HEAT OF METALS AND ALLOYS. Technical Note No. 4. Ralph Hultgren. June 1, 1960. 29p. Contract AF49(638)-83.

Lecture given at Third Annual Conference for Sponsors, March 29, 1960; Thermophysical Properties Research Center, School of Mechanical Engineering, Purdue University, Lafayette, Indiana.

The laws governing the specific heats of metals and alloys are discussed. The forms of energy which may contribute to specific heat such as harmonic and anharmonic atomic vibrations, dilation (Cp-Cv), and electronic excitation are discussed. (C.J.G.)

19529 AFOSR-TN-60-704

Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

ELECTRON DENSITY DISTRIBUTION IN A CYLINDER.

H. D. Weymann. July 1960. 10p. Project No. 9781. Contract AF49(638)-401. (BN-214).

The equilibrium density distribution of electrons of a given temperature in an infinitely long insulating cylindrical tube which is capable of withstanding any field strength was calculated. (C.J.G.)

19530 AFOSR-TR-59-103

Plasmadyne Corp., Santa Ana, Calif.

FUNDAMENTAL INVESTIGATIONS OF ELECTRICAL POWER SOURCES. VOLUME I. MORPHOLOGY. Emil J. Hellund. Apr. 24, 1959. 36p. Project 4750. Contract AF49(638)-332. (E-1FR049-332)

A survey and classification was made of various types of power sources which might possibly be used in conjunction with propulsion systems for space vehicles. Codification of these types was systematically developed with the objective in mind of providing a convenient classification

by means of which a rapid evaluation of any "new" proposals can be made. A number of possible new power systems and propulsion systems were brought out. The primary goal in evaluation of all systems is to obtain an unambiguous upper limit to performance, equivalent to that derived for heat engines on the basis of the Carnot cycle. It can be readily observed from the examples given that the basic conservation laws of physics are usually sufficient to settle the question of "feasibility" in regard to any proposal. (auth)

19531 AFOSR-TR-59-104

Plasmadyne Corp., Santa Ana, Calif.

FUNDAMENTAL INVESTIGATIONS OF ELECTRICAL POWER SOURCES. VOLUME VII—BIBLIOGRAPHIES. Helen Fife. Apr. 24, 1959. 49p. Contract AF49(638)-332. (E-7FR049-332).

This bibliography contains 379 references on electric power sources. The power sources are arranged according to whether they are internal (wholly contained within the space vehicle) or external (utilize energy available outside the vehicle), waste (utilize waste products from other functions) or direct storage, and certain detailed categories. (W.L.H.)

19532 ANL-6146

Argonne National Lab., Ill.

PHYSICS DIVISION SUMMARY REPORT [FOR] APRIL-MAY 1960. 48p. Contract W-31-109-eng-38. OTS.

A new method for the determination of the spins of neutron resonances from capture gamma-ray spectra is described. A study of the resonance levels of Na²⁴ was completed up to 860 kev. The levels were analyzed up to 630 kev and the distribution of the angular momenta, neutron widths, and level spacings is given. The study of the levels of F²⁰, and of lithium (present in the LiF sample), was started and data were obtained up to 280 kev. The "full" condition of a liquid-nitrogen cold trap is detected by a small carbon resistor working into a transistor d-c amplifier. An interesting sidelight on the loss of liquid nitrogen due to materials used in the transfer of the coolant is presented. The fluorescence spectrum of a commercial plastic scintillator was determined under various experimental conditions. Studies of the influence of temperature on the efficiency of energy transfer from naphthalene to anthracene in liquid solutions are reported. A detailed study was made of reduced widths extracted from the measured differential cross sections of stripping and pickup reactions. A method for computing the imaginary part of the Delbrück scattering amplitude was developed and applied for gamma energies of 2.62 and 6.14 Mev. The magnetic moments of the Λ and Σ hyperons were computed with the aid of mass spectral representations. (For preceding period see ANL-6130.) (W.D.M.)

19533 ARF-4132-9

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

EXPERIMENTS ON THE EXPLOSIVE DECOMPRESSION OF WATER. Period covered: April 1958 through January 1959. E. A. Brown. Nov. 1959. 82p. Contract AT(11-1)-528. OTS.

A two-inch diameter glass water-driven shock tube was set up in order to determine the feasibility of using such a device for the study of the explosive decompression of liquids, and to make exploratory observations of the phenomena involved in the sudden release of pressurized heated water into a region of lower pressure. On the basis of the results reported herein, it may be concluded that the apparatus is useful for the controlled study of such prob-

lems. The shock tube was operated with water in the driver section at 100°C and at pressures somewhat greater than atmospheric. The driven section contained air evacuated to various small fractions (less than about 0.4) of atmospheric pressure. It was found that the liquid expanded into a metastable state followed by a relaxation process to an equilibrium two-phase mixture; a compression wave was generated in the driven section. The measurements, primarily pressure-time records in the driver and driven sections, were compared with an approximate theoretical analysis which assumes a two-step, non-equilibrium type of expansion. Quantitative agreement with the theory was obtained; however, the analysis does not apply to operating conditions involving extremely low initial driven fluid pressures. In the range of conditions investigated, the metastable pressure appeared to be invariant at 8 psia. (auth)

19534 CAL-AD-1118-A-11

Cornell Aeronautical Lab., Inc., Buffalo.

HYPERSONIC RESEARCH SUMMARY. Final Report.

G. J. Fabian, June 1960. 28p. Contract AF18(603)-141. (AFOSR-TR-60-58).

Studies were made of pseudo-one-dimensional nozzle flows of pure dissociating oxygen. Equilibration of initially frozen flow by relaxation in a parallel duct was investigated. The results suggested that such equilibration of frozen flow would require ducts of impractical length as regards boundary layer development. Approximate methods developed for the analysis of such flows were applied to calculation of nonequilibrium airflow in typical hypersonic wind tunnel nozzles. On the basis of a simplified kinetic model of air, the results indicate that high reservoir pressures are essential if serious nonequilibrium effects are to be avoided in hypersonic wind-tunnel test flows at high stagnation enthalpies. The above mentioned approximate methods were applied to study the performance of a hydrogen rocket at low chamber pressures. At low pressures the chamber enthalpy is substantially increased by large dissociation. If the dissociation energy is recovered in flow expansion through the nozzle, large increases in specific impulse result. The results of the study showed that nonequilibrium effects (freezing of dissociation level) severely limit the impulse gain attainable in this way. The specific impulse did not increase monotonically with decreasing chamber pressure at constant chamber temperature but exhibited a well-defined maximum value. A "radiation probe" apparatus, utilizing ultraviolet absorption, was constructed for the measurement of the temperature of air in hypersonic flows without disturbing the flow conditions. The absorptive properties of high-temperature air, determined chiefly by the effects of O_2 , were investigated up to 4000°K. A generalized wave equation was derived for sound disturbances in a gas when relaxation effects connected with molecular vibration or dissociation are important. Solutions involving discontinuous wave fronts are presented and it was shown that, under certain assumptions, the complete wave equation reduces to a variant of the telegraph equation. Solutions were found for disturbance fields produced by a wavy wall in subsonic and supersonic flow, and a simple wedge in supersonic flow. The results showed that the equilibration process is strongly dependent on the particular flow in which relaxation occurs. Measurements of laminar and turbulent heat transfer to the walls of a shock tube were obtained over a wide range of operating conditions in air, argon, and oxygen, utilizing the methods of thin-film resistance thermometry. Boundary-layer transition data were obtained over a wide range of values of the ratio of wall-to-free-stream temperatures and for many pressures.

The transition results showed that at low cooling rates, transition depends chiefly on Reynolds number, while extreme cooling rates provide a marked stabilization. An effect of unit Reynolds number on the transition Reynolds number was observed at the lower shock Mach numbers. Thin coatings of silicon dioxide successfully insulated the thin-film gages from the ionized gas which approached temperatures to 3000°K. A molecular beam apparatus for determining equilibrium gas interactions at 1 to 10 ev was designed. (C.J.G.)

19535 CEA-1444

France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay.

COMPOTEMENT DES GAZ RARES DANS LES SOLIDES A HAUTE TEMPÉRATURE. (Behavior of Rare Gases in Solids at High Temperature). J. Blin. 1960. 49p.

A number of simple results regarding the solubility and displacement of rare gases in solids are assembled. These results were obtained from elementary considerations on highly compressed gases and on dislocations. They provide a better understanding of the now fairly numerous experiments dealing with the swelling of irradiated fuels, this swelling being due to the presence of a high proportion of gases in the fission products. Finally, the chances of success of the various methods which may be devised to diminish the swelling are examined. (auth)

19536 CERN-60-18

European Organization for Nuclear Research, Geneva.

Synchrocyclotron Div.

ON SMALL ANGLE MULTIPLE SCATTERING IN CONFINED BODIES. Helge Överås. May 10, 1960. 98p.

A method is given for calculating the effects of multiple scattering in bodies with complex shapes such as absorbers, collimators, counters, etc. Formulas are derived for both three-dimensional and projected scattering and the probability distribution of a particle passing a number of successive gates, the assumption being made that the scattering distributions are Gaussian, which is valid if the angles are small. Lateral displacements are considered in addition to angular distributions, and the energy losses in traversal of scatterers are taken into account. Some problems coming from CERN experiments are treated as an illustration of the method and its application. (D.L.C.)

19537 EOS-210-QL-4

Electro-Optical Systems, Inc., Pasadena, Calif.

STUDY OF ELECTRICALLY EXPLODED WIRE MATERIALS. Quarterly Progress Report No. 4 for Period April 1, 1959 to July 31, 1959. F. Webb. Aug. 25, 1959. 37p. Contract DA-04-495-ORD-1298. (AD-228063).

High energy densities were achieved of the order of 10 to 15 ev/atom under some conditions. Electrical conduction in very dense gases above the critical point is inferred. A rapidly expanding luminous zone (pre-shock wave) and its possible interaction with a rarefaction wave was observed. Some of the causes of the voltage and current wave forms as well as fast wire exploding mechanisms are discussed. (auth)

19538 JPL-TR-32-6

California Inst. of Tech., Pasadena. Jet Propulsion Lab. POWER GENERATION BY MEANS OF THE "ELECTRIC WIND." Meredith C. Gourdiene. Apr. 1, 1960. 11p. Contract NASw-6.

A generator in which charges are carried by a gas flow is analyzed. This generator converts flow energy into electrical energy at high voltages and low currents. Some of the possible engineering applications are: thermoelectric power conversion, power and voltage amplification, and electric-acoustic power conversion. (auth)

19539 KAPL-M-CHR-2

Knolls Atomic Power Lab., Schenectady, N. Y.
 MICROSCOPIC EFFECT IN MULTIPHASE MEDIUMS
 (NEUTRON SELF-SHIELDING). Charles H. Randall.
 May 27, 1960. 136p. Contract W-21-109-Eng-52. OTS.

Microscopic self-shielding factors were analyzed relative to determining a set of "homogeneous properties" that are equivalent to the original "heterogeneous properties" in respect to some specified response (e.g., scalar flux, reactivity, surface flux, average flux, etc.). An attempt was made to obtain an equation for the "average angular neutron flux." (C.J.G.)

19540 LMSD-288139(Vol. I, Pts. 1 & 2, Vols. II-IV)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.
 GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME I. FLUID MECHANICS. PART 1. 307p. PART 2. 205p. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 463p. VOLUME III. FLIGHT DYNAMICS AND SPACE MECHANICS. 462p. VOLUME IV. MATHEMATICS AND STATISTICS. 172p. Jan. 1960.

A series of papers is presented which deal with various topics in the fields of fluid mechanics, mechanics of deformable bodies, flight dynamics, space mechanics, and mathematics and statistics. Separate abstracts were prepared for 29 of 52 papers. (W.D.M.)

19541 LMSD-288139(Vol. II)(Paper 1)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

BUCKLING OF A CYLINDRICAL SHELL OF ARBITRARY LENGTH UNDER A CIRCUMFERENTIAL BAND OF PRESSURE. B. O. Almroth and D. O. Brush. Paper 1 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 40p.

A buckling analysis is presented for a circular cylindrical shell of arbitrary length subjected to a symmetrical band of pressure over a portion of the cylinder length. The results are useful for determining the allowable loads in motor cases and other thin-walled structures during handling and storage. The method uses a stability criterion based on the principle of minimum potential energy. The Rayleigh-Ritz procedure is used to expand the displacement components in trigonometric series. Results are presented in the form of graphs showing buckling pressure as a function of the ratios: cylinder radius/thickness; cylinder length/radius; and pressure bandwidth/cylinder length. It is found that, except for wide pressure bands, the buckling pressure is inversely proportional to bandwidth. It is also found that the buckling pressure is independent of cylinder length if the length is as much as five times the bandwidth. Results are in close agreement with existing solutions to special cases in which (1) the pressure is applied over the entire lateral surface, and (2) the pressure is concentrated along a circumferential line. (auth)

19542 LMSD-288139(Vol. II)(Paper 2)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

PREBUCKLING DEFLECTION STRESSES IN A CIRCULAR CYLINDER SUBJECTED TO A SADDLE-TYPE LOAD. B. O. Almroth. Paper 2 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 33p.

A method is presented for calculation of prebuckling

deflections and stresses in a cylinder of arbitrary length subjected to external pressure over a certain part of its length. The pressure may vary along the circumference such that $p = p_0 + p_1 \cos \varphi$, where p_0 and p_1 are arbitrary constants. Simple approximate formulas are given for lateral displacements, direct membrane stresses, and bending stresses. The analysis is based on elastic small deflection theory. (auth)

19543 LMSD-288139(Vol. II)(Paper 3)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

APPROXIMATE ANALYSIS OF DAMPED, LINEAR VIBRATIONS. T. R. Beal. Paper 3 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 14p.

A simplification in the analysis of the free motion of lightly damped linear systems is presented. The approximation is made that for arbitrary initial conditions, the various amplitude ratios in each natural mode are real numbers. This leads to a considerable simplification in the computation of the constants of integration and gives only small errors in the final results. (auth)

19544 LMSD-288139(Vol. II)(Paper 4)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

LARGE DEFLECTION AND BUCKLING ANALYSIS OF CIRCULAR CYLINDRICAL SHELLS. D. O. Brush. Paper 4 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 25p.

A variational procedure is used to derive equilibrium equations for the infinitesimal buckling of circular cylindrical shells. The nonlinear strain-displacement relations are based on a theory by Novozhilov for moderately-large shell deformations. It is shown that, for a large number of circumferential waves in an harmonic analysis of the displacement components, these relations reduce to those used by von Kármán and Tsien in their large-deflection analysis of the axially-loaded cylinder. It is also shown that the nonlinear strain-energy expression used by von Kármán and Tsien is also the strain-energy expression underlying the Donnell equations for infinitesimal buckling. (auth)

19545 LMSD-288139(Vol. II)(Paper 5)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

APPROXIMATE BUCKLING LOADS BY ENERGY METHODS. D. O. Brush. Paper 5 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959-JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 21p.

A systematic approximate method using energy analysis for determination of buckling loads in thin shells is presented. The method is of general applicability to static, conservative systems. Emphasis is placed on the underlying geometrical relationships and on the distinction between stationary and minimum potential energy. Application of the method is illustrated by a specific example—the buckling of a circular ring subjected to uniform external pressure. Correspondence between terms in this method of analysis and the method used by Timoshenko is illustrated. (auth)

19546 LMSD-288139(Vol. II)(Paper 8)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

A STATISTICAL ANALYSIS OF AXIALLY LOADED CYL-

INDER BUCKLING DATA. E. V. Pittner. Paper 8 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 34p.

A correlation is presented of experimental data with the shell radius/thickness ratio. Using the method of least squares and consulting tables of normal probability functions for small samples, the statistical mean of the buckling stress and its probability limits are determined for several r/t ranges from which design curves are developed. In addition to the statistical mean of the buckling stress for unpressurized cylindrical shells under axial compression, estimates are given for 90, 95, 99, and 1% failure-probability curves. A comparison of the estimated mean and the 90 and 99% probability curves with results of recent similar investigations shows that for the range $(r/t) > 250$ the presented design curves are lower than were expected and lower than any previously available design curves whereas beyond $(r/t) < 250$ the curves are slightly higher. (auth)

19547 LMSD-288139(Vol. II)(Paper 10)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ELASTO-PLASTIC ANALYSIS OF SHELLS OF REVOLUTION SUBJECTED TO HEATING AND EXTERNAL LOADS. E. Y. W. Tsui and P. Stern. Paper 10 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 26p.

An analysis is presented of stresses and deflections in shells of revolution subjected to rotationally symmetrical temperature gradients, surface tractions, and edge forces. The analysis is based on the theory of thin shells and the general assumptions of plasticity with the Huber-Mises-Hencky yield condition. The shell may be supported by elastic foundations. The thickness of shell may vary in the meridional direction. To provide for the plastic deformations under high temperature and/or external loads, a nonlinear stress-strain relation is introduced. The problem is solved by the Ritz method in conjunction with a procedure of successive approximations for the determination of plastic strains. (auth)

19548 LMSD-288139(Vol. II)(Paper 12)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

THE INITIAL RESPONSE OF AN ELASTIC SPHERICAL SHELL TO A STEP PRESSURE WAVE. P. M. Nachbar. Paper 12 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 39p.

An infinite series (mode) solution, used previously to study the effect of the impact of an acoustic pressure wave on an elastic spherical shell, is supplemented by a solution which describes the early response of the shell more simply and more accurately. Numerical results are obtained for the stresses and radial acceleration in a steel shell submerged in water. Two formulations of the problem are considered—one including interaction and one neglecting it—and the results are compared. It is found that the corrected values of the stresses at times shortly after impact are somewhat higher than those predicted by the first few terms of the series solution. However, while the changes are significant, they do not affect the time of occurrence of the maximum stress. It is also found that, except for times immediately after impact, the error introduced into the shell stresses by neglecting interaction is at least of the order of the error which results when just

the first two terms of the mode solution are used for the computation. Neglect of interaction also distorts the acceleration picture quite markedly. The radial acceleration at initial impact is cut by a factor of two. (auth)

19549 LMSD-288139(Vol. II)(Paper 13)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

THE EFFECT OF RESIDUAL STRESSES ON THE CRITICAL CRACK LENGTH PREDICTED BY THE GRIFFITH THEORY. W. E. Jahsman and F. A. Field. Paper 13 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 23p.

The Griffith theory for unstable crack length is modified to take into account the effect of residual (self-equilibrating) stresses. An expression relating the uniform stress, physical properties of the material, critical crack length, and the equilibrating strain energy is derived for a general residual stress distribution. This expression is used to develop a criterion for spontaneous cracking due to residual stresses alone. A specific numerical example for a parabolic residual stress distribution in a beryllium plate is carried out in some detail. (auth)

19550 LMSD-288139(Vol. II)(Paper 14)

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

STRESSES GENERATED BY SUDDENLY INTRODUCING A MOVING CRACK INTO A STRETCHED ELASTIC SHEET. B. R. Baker. Paper 14 of GENERAL RESEARCH IN FLIGHT SCIENCES, JANUARY 1959—JANUARY 1960. VOLUME II. MECHANICS OF DEFORMABLE BODIES. 68p.

A solution is obtained for a problem in which a growing crack suddenly appears in a stretched elastic plate. The problem is one of mixed boundary conditions on a half plane. Transform methods are used to obtain the Wiener-Hopf equation which is solved by standard techniques. Procedures for obtaining stresses at any point in the plane are outlined, and real integrals are presented for the transverse stress ahead of the crack and for the vertical displacement of the crack surface. The stresses for several values of crack speed are presented in a graph. It is found that the speed of Rayleigh waves plays an important role; for sub-Rayleigh crack speeds, the transverse stress has a tensile singularity; for super-Rayleigh speeds, the singularity is compressive. (auth)

19551 . ML-662

Stanford Univ., Calif. Microwave Lab.

BASIC MICROWAVE RESEARCH. Scientific Report No. 17. Quarterly Report No. 10 [for] July 1, 1959 to September 30, 1959. M. Chodorow. Nov. 1959. 28p. Contract AF19(604)-1930. (AFCRC-TN-60-101; AD-232521). OTS.

Research carried out in microwave tubes, plasma physics, and ferrite nonlinear microwave propagation at Stanford University is reported. (1) Microwave tubes. Work was done on the theory of coupled cavities by application of equivalent circuit methods to slow-wave microwave structures. The behavior of velocity-modulated electron beams in long gaps was investigated; methods for increasing bunching efficiency are described. Resonant helices were studied in order to understand electron beam parametric amplification, and amplification using pumps is suggested. (2) Plasma physics. The purpose of this research is to understand propagation of electromagnetic waves through plasmas. Equations were derived for a finite electron beam in a finite plasma column with and

without a strong magnetic field. Attenuation experiments indicate that attenuation of electron waves is proportional to the square root of the electron temperature. A new method for the elimination of standing waves on the plasma column is described. A plasma guide system 1 inch in diameter was constructed for measuring nonlinear effects in a parametric amplifier; a pole piece enables it to confine the plasma over a longer length. Attempts were made to measure electrostatic sound waves and indicate that fast electron waves, but not ion waves, are present. Sturrock's pseudo-confinement theory was tested for its low-frequency cutoff (below which no amount of r-f power can produce confinement) and for the potentials on the inner wall; in both tests, the results confirmed the theory. Experiments were made to produce thermal plasma (with equal electron and ion temperatures) with a traveling-wave tube, but no thermal plasma was detected. A method for producing a thermal cesium plasma to be tried is described. Methods for obtaining plasma information by two-frequency correlations in plasma noise are being studied. Harmonic-frequency generation experiments in plasma done in the past are analyzed, and it is believed that harmonic generation arises from the a-c currents' nonproportionality to the a-c fields and that experiments in which r-f power is not wasted in plasma ionization are more suitable for studies of harmonic generation. (3) Ferrite nonlinear microwave propagation. The theory of frequency doubling in ferrite-loaded propagating structures was studied using perturbation analysis. (D.L.C.)

19552 MRL-69

Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group and Watertown Arsenal. Materials Research Lab., Mass.

HARTREE-FOCK ATOMIC SCATTERING FACTORS FOR THE IRON TRANSITION SERIES. R. E. Watson and A. J. Freeman. Jan. 1960. 33p. DA Project No. 5-93-32-001. (AD-232654).

Atomic scattering factors for thirty-five atoms and ions of the iron group transition series (Sc through Cu) were determined from Watson's calculation of Hartree-Fock wave functions and compared with previous calculations. Principal scattering factors were computed, following the methods of Freeman, for the 3d electrons of those atoms containing nonspherical charge distributions. As was shown by Weiss and Freeman, these factors are all that are needed for determining (from the measured neutron form factor) the spatial symmetry of the outer electrons in magnetic materials. Argon core scattering factors were calculated, and, on the basis of these new results, the question of the constancy of the argon core is discussed quantitatively. (auth)

19553 NAA-SR-Memo-2654

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FLUX EVALUATION OF MTR IRRADIATED NAA-15 ASSEMBLIES. M. Roy. Apr. 10, 1958. 3p. OTS.

Flux values of MTR irradiated NAA-15 assemblies are reported at the most probable velocity for a Maxwellian distribution at room temperature. The estimated flux was calculated relative to a previously calibrated Al-Co alloy wire. (C.J.G.)

19554 NAA-SR-Memo-4705

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A PROPOSED MONTE CARLO METHOD FOR COMPUTING THE BASIC LATTICE PARAMETERS AND THE SPACE DEPENDENT NEUTRON SPECTRA. G. D. Joanou. Dec. 7, 1959. 28p. OTS.

A Monte Carlo method is proposed for computing basic lattice parameters and space-dependent neutron spectra. The method follows neutron histories through many generations, the total number depending on the statistical uncertainty desired. The major differences in the proposed Monte Carlo scheme and previous Monte Carlo calculations are enumerated. The use of neutron weights is introduced into the routine for the calculation of the fast fission factor. The calculation of the resonance escape probability employs the use of doubling surfaces in the moderator. In computing the thermal utilization, the thermal neutron spectrum is not assumed to be in the usual Wigner-Wilkins form but is calculated for every region. The effects of spectral hardening and epithermal fission are included. The neutron flux is calculated according to the definition that the neutron flux is proportional to the sum of the path lengths per cubic centimeter. The proposed method is applicable to computing thermal neutron spectra in both homogeneous and heterogeneous lattices. (C.J.G.)

19555 NASA-TN-D-285

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

SATELLITE AND SPACE PROPULSION SYSTEMS.

Wolfgang E. Moeckel, Lionel V. Baldwin, Robert E. English, Bernard Lubarsky, and Stephen H. Maslen. June 1960. 48p. OTS.

A study of low-thrust systems for space and satellite propulsion is presented. Particular emphasis is placed on electric propulsion. The characteristics of electric power generators and thrust generators are reviewed. Electric propulsion systems are compared to chemical and nuclear rockets for satellite sustaining and orbit control, and for manned and unmanned missions to Mars. (auth)

19556 NAVORD-8749

Naval Ordnance Lab. Explosives Research Dept., White Oak, Md.

EQUATION OF STATE OF WATER. Andre' N. Gleyzal and Hans G. Snay. Dec. 9, 1959. 28p.

Thermodynamic quantities for water such as γ , S , and p as functions of temperature are calculated for temperatures sufficiently high to cause dissociation of the molecule. Thermochemical equilibrium is assumed and the Wilson-Kistiakowsky equation of state is employed. Two types of corrections for the electrostatic force, an "unsold correction" and a "Debye-Hückel correction" are discussed but not used in the numerical calculations. (auth)

19557 NB-60-16

Norair. Div. of Northrop Corp. Astro Systems and Research Labs., Hawthorne, Calif.

DESIGN AND APPLICATIONS OF PROPULSIVE FLUID ACCUMULATOR SYSTEMS. Sterge T. Demetriades. Apr. 1960. 162p.

The fundamental morphological study is summarized which revealed the advantages of the Propulsive Fluid Accumulator system over conventional rockets. A comparison of launch mass, energy and power requirements for various missions where PROFAC is used with various missions where other conventional nuclear, chemical, or hybrid systems are used is presented. Frequent refuelling with propulsive fluid collected in orbit and/or on the surface of satellites or planets offers several practical advantages over an increase of specific impulse. The propulsion and other requirements of the Orbital Vehicle used to overcome the drag of collection of air in orbit at altitudes of 90 to 120 km and the characteristics of a magnetogasdynamic device for electrical orbital propulsion at that altitude are discussed. The basic design and optimization

procedures for the Space Vehicles and Orbital Vehicles making up the PROFAC system and optimization of the general single-stage electrical rocket and the mixed-stage (where a chemical stage is followed by an electrical stage) rocket with rendezvous-and-return capability (i.e., where the electrical stage returns to rendezvous with the chemical stage and the latter returns both stages to the starting point). It is concluded that exhaust velocities less than 30,000 m/sec are necessary for most manned missions within the solar system unless the specific weight of the power generator is reduced to below 1 kg/kw. This maximum value of the optimum exhaust velocity is reduced even further for mixed-stage rockets with rendezvous-and-return capability. The velocity requirements and the preliminary design of PROFAC systems for various orbital, lunar and interplanetary missions are presented. It appears that an order-of-magnitude decrease of the cost of space missions is possible by use of PROFAC and it is shown how for most types of missions this system is competitive with other advanced schemes such as the nuclear pulse (explosion) rocket. For example, a 44,000 lbm payload can be delivered to the moon for every 57,000 lbm lifted to 100-km orbit around the earth. Considerable possibilities exist for further improvement of the PROFAC system. (auth)

19558 NBS-TN-47

National Bureau of Standards, Washington, D. C.
AN IMPROVED HYDROGEN ATOM BEAM FURNACE.
Ralph Klein and John Pararas. May 1960. 8p. (PB-151406).

The design and fabrication of a seamless tungsten furnace for use in a hydrogen atom-beam apparatus are reported. The method of mounting the furnace is described. (C.J.G.)

19559 NP-8755

Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
QUARTERLY PROGRESS REPORT NO. 57. J. B. Wiesner, G. C. Harvey, and H. J. Zimmermann. Apr. 15, 1960. 204p. Contract DA-36-039-sc-78108.

Research activities for the quarter ending Feb. 29, 1960, are reviewed. Progress is indicated in the fields of physical electronics, plasma dynamics, statistical thermodynamics, thermoelectric processes and materials, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, modulation theory and systems, statistical communication theory, processing and transmission of information, physical acoustics, speech communication, signal detection by human observers, communications biophysics, neurophysiology, circuit theory, network synthesis, satellite time-dilation measurement, and sensory aids research. (For preceding period see NP-8496.) (W.D.M.)

19560 NP-8839

Avco Corp. Avco-Everett Research Lab., Everett, Mass.
MAGNETOHYDRODYNAMIC ENERGY CONVERSION TECHNIQUES. Research Report 86 (formerly Research Note 120). Richard J. Rosa and Arthur R. Kantrowitz. Apr. 1959. 20p.

The basic theory of magnetohydrodynamic (MHD) generators, the characteristics of such devices, and the electrical properties of gases are discussed. In order to study electrical conductivity and magnetohydrodynamic flow phenomena, several shock tube experiments were performed. Results indicated that the MHD generators would be restricted to relatively high power, in excess of one megawatt, applications. Due to the absence of hot,

highly stressed moving parts, an MHD generator could handle very high temperature gases. (M.C.G.)

19561 NP-8847

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

NEUTRON DIFFRACTION STUDIES IN SOLID STATE PHYSICS. K. Blinowski. 1960. 21p.

The experimental methods used in neutron diffraction studies at the Institute of Nuclear Research in Warsaw are described. Results of slow neutron spectrum measurement, cold neutron production, structural investigation of PbO, WC, and FeS₂ (magnetic structure), and study of parasitic Bragg reflection observed in the neutron spectrum from crystal monochromators are presented. (auth)

19562 NRL-5475

Naval Research Lab., Washington, D. C.
SOURCE AND DETECTOR CORRECTIONS FOR ANGULAR CORRELATION MEASUREMENTS. F. C. Young. Feb. 18, 1960. 10p.

The geometrical corrections to the angular correlation function for circular detectors with spherical and cylindrical sources were calculated. The calculations were made to second order in terms of the various geometrical parameters, and curves were plotted showing the dependence of the corrections on these parameters, as well as on the correlation angle. The parameters were: the angle between the two gamma rays, the angle between the symmetry axes of the two detectors of solid angle $d\Omega_1$ and $d\Omega_2$, the radius of the detectors, the radius of the source, and the distance from the source to the center face of each detector. An extension of these corrections to include cylindrical detectors was investigated and the results were of the same mathematical form as for circular detectors. (auth)

19563 NRL-Memo-1037

Naval Research Lab., Washington, D. C.
STATUS REPORT ON THERMOELECTRICITY. J. W. Davisson and Joseph Pasternak. Mar. 1960. 183p.

The results of previous investigations on the thermal conductivity and thermoelectric power of thermoelectric materials are contained. Data on the thermoelectric power and resistivity of some silicides are presented. Previously determined thermoelectric properties of ternary compounds of selenides and tellurides are given. (C.J.G.)

19564 SCTM-314-59(15)

Sandia Corp., Albuquerque, N. Mex.
OUTPUT FORMAT CONSIDERATIONS FOR DIGITAL AUTOMATIC DATA RECORDING. E. C. Dowling. Feb. 3, 1960. 55p. OTS.

Raw test data after leaving the acquisition system generally are stored, processed, or both. In order that this data be usable to the desired degree, the arrangement or format of this data must be standardized to be compatible with processing apparatus. For acquisition systems of high flexibility, such as APAR, these limitations initially seem oppressive; however, the resulting usability of the data justifies any reasonable restrictions of format. (auth)

19565 SUDAER-78

Stanford Univ., Calif.
A THEORY OF ELASTIC, PLASTIC AND CREEP DEFORMATIONS OF AN INITIALLY ISOTROPIC MATERIAL SHOWING ANISOTROPIC STRAIN-HARDENING, CREEP RECOVERY, AND SECONDARY CREEP. J. F. Besseling. Dec. 1959. 41p. Contract AF49(638)-223. (AFOSR-TN-60-384).

Stress-strain relations are given for an initially isotropic material, which is macroscopically homogeneous,

but inhomogeneous on a microscopic scale. An element of volume is considered to be composed of various portions, which can be represented by subelements showing secondary creep and isotropic work hardening in plastic deformation. If the condition is imposed that all subelements of an element of volume are subjected to the same total strain, it is demonstrated that the inelastic stress-strain relations of the material show anisotropic strain-hardening, creep recovery, and primary and secondary creep due to the non-uniform energy dissipation in deformation of the subelements. Only quasi-static deformations under isothermal conditions are considered. The theory is restricted to small total strains. (auth)

19566 SUDAER-84

Stanford Univ., Calif.

A THEORY OF SMALL DEFORMATIONS OF SOLID BODIES. J. F. Besseling. Feb. 9, 1959. 112p. Contract AF49(638)-223. (AFOSR-TN-59-605; AD-217172).

A theory is presented that is capable of giving a mathematical description of the following phenomena observed in the deformation and heating of solid bodies: thermal stresses, thermoelastic damping of vibrations, dynamic and static moduli, Bauschinger effect and other anisotropic hardening phenomena in plastic deformation, primary creep preceding the secondary stage of steady creep under constant stress, creep recovery, and stress relaxation. The variational principles of thermoelasticity, creep, and plasticity are all derived from one thermodynamic variational principle which is formulated with the aid of the entropy displacement field introduced by Biot. Thermoelastic damping of bending vibrations of beams and creep damping of pure shear vibrations are considered. (auth)

19567 SUDAER-88

Stanford Univ., Calif.

BUCKLING OF A THIN CIRCULAR CYLINDRICAL SHELL HEATED ALONG AN AXIAL STRIP. D. W. Hill. Dec. 1959. 99p. Contract AF49(638)-223. (AFOSR-TN-59-1250).

The buckling of a thin circular cylindrical shell heated along a narrow strip in the axial direction is considered. The problem was solved using the Ritz method, assuming for the displacements Fourier series modified by a shape factor chosen to magnify the solution in the vicinity of the heated strip. The convergence rate of the solution was found to be greatly increased by the shape factor. In the analysis of the stress distribution, the cylinder is assumed to be simply supported on its ends so that the radial and circumferential displacements there are zero, but the axial displacements and end rotations are not restricted. In the calculation of the stability, a simplified thermal stress distribution is assumed which is the one prevailing in the middle of the cylinder. The stresses are assumed to vary around the circumference but to be constant in the axial direction. Expressions are given relating the physical parameters of the cylinder, the temperature distribution, and the magnitude of the temperature causing buckling. Experimental results are presented for buckling tests on eleven cylinders. The experimental results were in reasonable agreement with the theoretical calculations. The modified Fourier series assumed for the displacements are shown to converge to the true solution as the number of terms included becomes indefinitely large. For practical purposes the convergence is so rapid that a single term gives results correct to within a few percent. Courant's maximum-minimum principle is used to establish that the buckling stress for a cylinder under uniform axial compression is a lower bound for all other cases of

axial loading, provided that the buckling stress is taken as the maximum compressive stress on the cross section. (auth)

19568 SUDAER-89

Stanford Univ., Calif.

THE STRESSES IN AN ELASTO-PLASTIC BAR SUBJECTED TO A SUDDEN CHANGE OF SURFACE TEMPERATURE. E. W. Parkes. Jan. 1960. 21p. Contract AF49(638)-223. (AFOSR-TN-60-321).

An analysis is given for the stress history in an elasto-plastic bar subjected to a sudden change of surface temperature. The type of behavior is found to depend on the ratio of thermal strain (αV) to yield strain (σ_y/E). For $E\alpha V/\sigma_y < 1$, the stresses are entirely elastic. For $1 < E\alpha V/\sigma_y < 2.04$ there are two transient zones of compressive yielding. For $2.04 < E\alpha V/\sigma_y < 4.4$ there are two transient zones of compressive yielding and two enduring zones of tensile yielding. For $E\alpha V/\sigma_y > 4.4$ there are two transient zones of compressive yielding, one transient zone of tensile yielding, and two enduring zones of tensile yielding. The investigation is restricted to the range $0 \leq E\alpha V/\sigma_y \leq 5$ and the particular case $E\alpha V/\sigma_y \rightarrow \infty$. Detailed solutions are given for $E\alpha V/\sigma_y = 1, 2, 3, 4, 5$, and ∞ . (auth)

19569 SUDAER-91

Stanford Univ., Calif.

THERMOELASTICITY. E. W. Parkes. Feb. 1960. 92p. Contract AF49(638)-223. (AFOSR-TN-60-380).

Thermal and elastic constants were determined, and equations to govern the resulting thermo-elastic constants were derived. Thermo-elastic equations were derived for a medium in which there are no internal body forces and no deliberate generation of heat. Boundary conditions were established to satisfy the above problem. Equations are derived which describe heat flow in a plane and a slab. Elastic thermal stresses and their effects on stiffness are discussed. (C.J.G.)

19570 SUDAER-92

Stanford Univ., Calif.

INFLUENCE COEFFICIENTS FOR RADIATION IN A CIRCULAR CYLINDER. E. W. Parkes. Mar. 1960. 13p. Contract AF(638)-223. (AFOSR-TN-60-415).

A table of influence coefficients is calculated from which the distribution of absorbed radiation in a long circular cylinder having any distribution of emitted radiation can readily be determined. Lambert's law of diffuse emission and reflection is assumed, and the coefficient of absorptivity is supposed constant. A table of functions for the distribution of reflected radiation after each reflection up to the tenth is also given, so that the results can be compared with non-Lambertian systems. (auth)

19571 TID-6040

Brown Univ., Providence.

PROGRESS REPORT AND RENEWAL PROPOSAL FOR A RESEARCH PROGRAM IN EXPERIMENTAL AND THEORETICAL HIGH-ENERGY PHYSICS. David Feldman and Anatole M. Shapiro. June 1, 1960. 18p. Contract AT(30-1)-2262. OTS.

The progress which was made during the contract year is briefly summarized, and a proposal is made for continuation of the program. The present status and proposed plans are given for the bubble-chamber research program, the nuclear emulsion research program, and the theoretical group. (W.D.M.)

19572 TNCC(UK)-62

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE TREATMENT OF THERMAL NEUTRON SCATTERING LAW DATA. P. A. Egelstaff. 1960? 34p. (EANDC(UK)-1).

The relationship between the neutron scattering law and the neutron spectrum in a moderated system is discussed. In addition the fundamental theory of the scattering law and the methods of combining theory and experiment in order to extrapolate the measurable part of the law to infinity are described. It is concluded that (1) the neutron spectrum is sufficiently insensitive to the scattering law, that errors in the latter are probably reduced 10 times in the calculation of the neutron spectrum, (2) calculations should be undertaken to establish more exactly the magnitude of this effect, and (3) although the theory is just adequate for present needs, it will be necessary to extend it in the near future to cover anharmonic effects in crystals and the behavior of the self-diffusion function in liquids. (auth)

19573 USNRDL-TR-424

Naval Radiological Defense Lab., San Francisco.

A FLASH METHOD OF DETERMINING THERMAL DIFFUSIVITY, HEAT CAPACITY, AND THERMAL CONDUCTIVITY. W. J. Parker, R. J. Jenkins, C. P. Butler, and G. L. Abbott. May 20, 1960. 27p.

A flash method of measuring the thermal diffusivity, heat capacity, and thermal conductivity is described. A high-intensity short-duration light pulse is absorbed in the front surface of a thermally insulated specimen a few millimeters thick coated with camphor black, and the resulting temperature-history of the rear surface is measured by a thermocouple and recorded with an oscilloscope and camera. The thermal diffusivity is determined by the shape of the temperature-versus-time curve at the rear surface, the heat capacity by the maximum temperature indicated by the thermocouple, and the thermal conductivity by the product of the heat capacity, thermal diffusivity, and the density. These three thermal properties were determined for Cu, Ag, Fe, Ni, Al, Sn, Zn, and some alloys at 20 and 135°C and compared with previously reported values. (auth)

19574 WADC-TR-59-291

Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.

ION ROCKET RESEARCH DEVICE. Final Report. R. H. Boden. May 1959. 126p. Contract AF33(616)-5927. (R-1455; AD-226659).

The variation of several engine design parameters as a function of operating voltage is evaluated for the ion rocket device using cesium as the propellant. The required current density and propellant aperture were calculated. Various electrode configurations and focusing techniques were evaluated. Design and fabrication details of a 0.20 lb thrust ion thrust chamber are contained. Design and operation of a vacuum test chamber that will simulate an altitude of 100 miles and is large enough for operating ion rocket motors having thrusts up to 0.2 pounds are discussed. Pumping, piping, and electrical systems of the vacuum test chamber are described. Instrumentation for measuring thrust, temperatures, detection of neutral particles, propellant flow-rate, pressures in propellant feed system, ion beam power, coolant flow, electrical power, radiation shield calibration, and particle velocity is described. (C.J.G.)

19575 WADC-TR-59-640

General Mills, Inc., Minneapolis.

ELECTRON MIRROR MICROSCOPY IN MAGNETIC AND METALLURGICAL STUDIES. Final Report. Ludwig J. Mayer. Oct. 1959. 80p. Project 7021. Contract AF33(616)-3852. OTS.

The first four sections of this report deal with the electron mirror microscope's feasibility as a research tool in

the study of magnetism. First, it is demonstrated that electron mirror microscopy can be utilized for the observation of magnetic patterns recorded on magnetic tapes. Then, it is shown that electron mirror microscopy reveals magnetic domain patterns not only in magnetic materials with a uniaxial direction of easy magnetization but also in materials with several directions of easy magnetization exhibiting basically flux closure domain configurations. On silicon-iron three types of domain manifestations were observed. Motion pictures photographed directly from the screen of the electron mirror microscope portray quite adequately the domain patterns set in motion by applied magnetic fields. Experimental evidence is presented that electron mirror microscopy is particularly well suited for direct visual observation of magnetic stray fields at grain boundaries. Appearance and growth of magnetic stray fields at grain boundaries in silicon-iron were observed as a function of externally applied magnetic fields and motion picture recordings were taken which demonstrate that grain boundaries can behave quite differently, stray field-wise. It is also possible to observe domain and domain movement in the different types of thin magnetic films. The next four sections of the report deal mainly with thin manganese bismuthide (MnBi) films. Experimental evidence is presented that a method of magnetic writing is possible which is based on a local reversal of the direction of magnetization in suitable premagnetized film by temporarily elevating the temperature above the Curie point. By utilizing the dissipation energy of a focused electron beam for this purpose quite well defined traces of reversed magnetization could be recorded on MnBi films. These traces were erasable magnetically. Writing speeds of 3×10^4 bits/sec and information densities of 10^8 bits/cm² could be achieved. With a newly designed vacuum hot stage, the formation of MnBi films was observed by means of the Kerr magneto-optic effect, thus achieving for the first time visual observation of the nascent state of ferromagnetism. Experiments devised to provide information about the nucleation probability of MnBi films are then described which reveal that uniform MnBi films grow from only a few randomly distributed nucleation spots. Preliminary results of experiments aimed at magnetic manganese antimonide (MnSb) films are reported. In the next section it is explained why electron mirror microscopy cannot be expected to become a promising research tool in the field of order-disorder phenomena. The report closes with a phenomenological description of strange noise-like, wave-like, and bubble-like electrical charge movements on amorphous selenium films made visible in a unique way by electron mirror microscopy. In an appendix four auxiliary devices, i.e., a hot stage specimen holder, a cold stage, a vacuum heat treating furnace and an electron optical bench are described. (auth)

19576 WADD-TR-60-468

Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

HIGH VELOCITY ELECTRIC ACCELERATOR SYSTEMS.

Period covered: April 1958 to June 1960. Jordan J.

Baruch, Denis U. Noiseux, Jay H. Ball, and Creighton M. Gogos. June 1960. 148p. Project Nos. 7360 and 7351.

Contract AF33(616)-5730.

Accelerators designed to convert electric energy to projectile kinetic energy were investigated. The four electric techniques used were: exploding coil, induction accelerator, accelerated plasma, and gas heating. Actual speeds up to 14,500 ft/sec were obtained with a 20,000-joule energy input. (D.L.C.)

19577 WAL-TR-145/18

Watertown Arsenal Lab., Mass.

MAGNETIC INSPECTION OF PROJECTILES BY INDUC-

TION TECHNIQUES. Patrick C. McEleney and Vincent H. Early. Nov. 1959. 16p. OTS.

An automatic flaw detector for projectiles utilizing the magnetic induction method was developed for fully automatic inspection of high explosive shell bodies and armor-piercing shot of sizes 75mm through 120mm. A discussion of the over-all principles of operation, electromechanical and electronic circuits, and present status of equipment is presented. (auth)

19578 WAPD-BT-18(p.29-32)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

STRESS AND DEFLECTION OF A FREE RING OF RECTANGULAR SECTION UNDER THE ACTION OF A LINEAR THERMAL GRADIENT. S. J. Becker. p.29-32 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

The solution of a thermal stress problem for a ring is obtained by methods that were developed for pressure loading and reported in the Bettis Technical Review. The assumptions and limitations of the problem are outlined, and simple validity checks are obtained. Extensions of the method are indicated. (auth)

19579 WAPD-BT-18(p.33-52)

Westinghouse Electric Corp. Research Labs., Pittsburgh. PHOTOELASTIC ANALYSIS OF STRESSES IN PERFORATED MATERIAL SUBJECT TO TENSION OR BENDING. R. C. Sampson. p.33-52 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

"Frozen stress" tests of perforated specimens in tension and bending revealed hole boundary stress distributions for uniaxial load. Extension of the usefulness of the test data to include any degree of biaxiality of tension or bending was accomplished by superposition. Some insight into the three-dimensional character of the stress distribution is provided. (auth)

19580 WAPD-BT-18(p.53-73)

Westinghouse Electric Corp. Research Labs., Pittsburgh. PHOTOELASTIC DETERMINATION OF STRESSES IN TUBE SHEETS AND COMPARISON WITH CALCULATED VALUES. M. M. Leven. p.53-73 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

Tests of perforated circular plates, simply supported and uniformly loaded, have resulted in measured stresses and deflections which agree closely with those calculated using the effective elastic constants ν_e' and E_e' and the stress-ratio factor F_e obtained experimentally by Sampson. The agreement between calculated and experimental stresses and deflections gives support to the general method of calculating stresses and deflections in tube sheets. In this general method, if the effective elastic constants ν' and E' and the stress-ratio factor F can be determined for a particular penetration pattern, then the maximum ligament stress and deflection can be calculated for any conditions of support and loading. (auth)

19581 WAPD-BT-18(p.75-84)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

FORCED VIBRATION OF A CANTILEVER TUBE IN AIR AND WATER. J. A. Keane. p.75-84 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

It can be shown, both analytically and by experiment, that the natural frequency of a body vibrating in a fluid is lower than that of the same body vibrating in a vacuum. This effect can be quite important in the design and analysis of fluid moderated and/or cooled reactor components, where it is necessary to keep the natural frequency well above expected external excitation frequencies such as are pro-

duced by ship's propellers. The results of an experiment are presented in which the response of a cantilever tube was compared for two fluid media—air and water. (auth)

19582 XDC-60-3-212

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

CALIBRATION OF AN 8" x 8" SODIUM IODIDE (TI) CRYSTAL. W. L. Weiss. Mar. 24, 1960. 28p. OTS.

Graphic representation is presented of data obtained with an 8 in. x 8 in. sodium iodide (TI) crystal in conjunction with three 3-inch photomultiplier tubes (Dumont 6363). The system was found to be linear to within 1%, up to 9 Mev, and to exhibit a resolution of 9.7% and a photofraction of 63% for a cesium-137 gamma source. (auth)

19583 JPRS-2785

DETONATION PROCESSES. K. I. Schelkin. Translated from *Vestnik Akad. Nauk S.S.S.R.* 30, No. 2, 12-20(1960). 19p. OTS.

The processes involved in gas detonations are examined. A review of development in this area is given, and an appraisal of the current research status is presented. A theory is offered which holds that the spin nucleus in detonation is an oblique shock wave in which the mixture is ignited more readily than in a plane wave since the temperature and pressure in it are significantly higher. When the extent of the oblique shock is comparable to the radius of the tube, a single headed spin appears and if the diameter is increased, a multi-headed shock wave may appear. The spin may be eliminated by directing it into a severely roughened tube. Other aspects of the detonation theory are discussed, and results of application of this theory to combustion in a rocket chamber are given. (J.R.D.)

19584 JPRS-2842

STUDIES OF THERMODYNAMIC PROPERTIES OF SUBSTANCES WITH THE AID OF THE METHOD OF EXPLOSION IN A SPHERICAL BOMB. V. A. Medvedev. Translated from *Zhur. Fiz. Khim.* 32, 1851-8(1958). 13p. OTS.

It was shown that under conditions of explosion in a spherical bomb the combustion products were in complete thermodynamic equilibrium at the moment of attainment of maximum pressure. The values of the heat losses incurred from the beginning to the end of the burning of the mixture were calculated. Regularities were established for the values of heat losses, which permitted the evaluation of heat losses of mixtures not examined. The method of calculating the energies of dissociation of gases with the aid of measured maximum pressures of the explosion was demonstrated. (W.L.H.)

19585 JPRS-2846

ISOTOPE EXCHANGE BETWEEN A SOLID BODY AND A GAS. S. N. Oziraner. Translated from *Problemy Kinetiki i Kataliza, Akad. Nauk S.S.S.R., Inst. Fiz. Khim., Soveshchaniye, Moscow, 1956* 9, 267-73(Publ. 1957). 12p. OTS.

The conditions for the isotope exchange process between a gas and a solid body were investigated mathematically. (W.L.H.)

19586 NP-tr-461

RESEARCH IN THE FIELD OF ELECTRIC DISCHARGE IN GASES. (Issledovaniya v Oblasti Elektricheskogo Razryada v Gazakh). B. N. Klyarfel'd. (Translated from a publication of the State Publishing House for Energetics, Moscow-Leningrad, 1958). 307p. OTS.

A collection of research papers is presented on the physics of electric discharges in gases. The papers pertain to the following subjects: production of electric discharge on

application of high voltages to the electrodes of gas-discharge devices, behavior and properties of the cathode spot formed on the Hg surface, methods of observation of the gas density on passage of heavy currents through discharge devices, and distribution of current density over the surface of the anodes of Hg-arc rectifiers. (W.L.H.)

19587 NP-tr-463

MASS-SPECTROMETRIC SOURCE OF IONS WITH SURFACE IONIZATION. (Mass-Spektrometricheskiiy Isotochnik Ionov s Poverkhnostnoy Ionizatsiyey). B. G. Safronov, Yu. S. Azovskii (Azovskiy), and G. G. Aseev (Aseyev). Translated from *Pribory i Tekh. Ekspt.* No. 6, 80-2(1957). 6p. OTS.

A mass spectrometer ion source with surface ionization was designed which permitted measurement of the isotopic composition of substances present in amounts as small as 5×10^{-7} g. This source was tested in an investigation of the isotopic composition of rubidium, and the results were compared with those obtained by other methods. The applicability of the source was found to be limited to alkali and alkaline earth metals which have very low ionization potentials. (M.C.G.)

19588 SCL-T-308

TESTING OF THE MECHANICAL SEISMOGRAPHS CMP-II (SMR-II) IN ORDER TO EVALUATE THE DIMENSIONS OF A SEISMICALLY DANGEROUS ZONE DURING A MASSIVE EXPLOSION. (Opyt Ispol'zovaniia mekhanicheskikh Seismografov SMR-II s Tsel'u Otsenki Razmerov Seismopasnoi Zony Pri Massovom Vzryve). V. I. Bune and A. A. Kon'kov. Translated by Marcel I. Weinreich (Sandia Corp.) from *Trudy Inst. Seismol., Akad. Nauk Tadzhik. S.S.R.* 71, 47-58(1957). 15p. JCL.

The results of an evaluation of the dimensions of a seismically dangerous zone during the explosion of 1800 tons of ammonite are reported. The interpretation of data obtained from mechanical seismograms at distances of 600 to 1200 m from the explosion is discussed. (C.J.G.)

19589

RETARDED AND ADVANCED GREEN FUNCTIONS IN THE QUANTUM THEORY OF ISOTROPIC FERROMAGNETICS. Pu Fu-cho, S. V. Tyblikov, and T. Shiklós. *Acta Phys. Acad. Sci. Hung.* 11, 323-31(1960). (In Russian)

Retarded and advanced Green functions were used for the calculation of the fundamental thermodynamical characteristics of isotropic ferromagnetics. Magnetization results obtained by this method are valid for all temperatures. The orientation of the resulting magnetization with respect to the external magnetic field was not assumed in advance. This gave the possibility of investigating more complicated problems in the theory of magnetism. (auth)

19590

THE VARIATIONAL FORMULATION OF THE MAGNETO-HYDROSTATIC EQUATIONS. P. C. Kendall (Univ. of London). *Astrophys. J.* 131, 681-3(1960) May.

It is shown that stationary values of the potential energy of a general hydromagnetic system correspond to all equilibrium states. This variational method is equivalent to solving the magneto-hydrostatic equations in a general form. (auth)

19591

EXCHANGE EFFECTS ON THE PHOTODETACHMENT CROSS-SECTION OF H^- . T. L. John (University Coll., London). *Astrophys. J.* 131, 743-4(1960) May.

It has been shown that little further improvement in the calculated H^- photodetachment cross section is likely to result from using more complicated H^- wave functions.

Results are given for cross section calculations using the 20-parameter H^- function and the dipole velocity formula. The results of Chandrasekhar and Elbert, using central-field functions, are compared to these using the exchange-wave functions. (B.O.G.)

19592

INFLUENCE OF TEMPERATURE ON THE SPECTRAL COMPOSITION OF THE ZINC SULPHIDE LUMINESCENCE. I. Soudek (Research Inst. for the Vacuum-Electrotechnics, Prague). *Brit. J. Appl. Phys.* 11, 289-92(1960) July.

The temperature dependence of the spectral composition was presented by a new method which shows better the relative changes of the form of the emission band. On the main emission band of some zinc and zinc-cadmium sulfides, between the liquid air temperature and the temperature break-point, certain effects were observed; these are that (a) below 180°K the short wave side of the emission band of all phosphors grows faster than the long wave side with increasing temperature, (b) that in the neighborhood of 220°K, the intensity of the whole band has a minimum for all copper-activated and copper-contaminated phosphors, and that (c), above 220°K, some phosphors behave inversely as (a). These effects can be explained by the existence of two temperature-dependent processes having inverse influence on the form of the emission band, one being similar to the hole-migration process and the other being in connection with the thermal liberation of trapped electrons. (auth)

19593

LUMINESCENCE OF DEUTERATED DERIVATIVES OF BENZENE, d_1 AND d_2 -PARA, IN DILUTE SOLUTION IN CYCLOHEXANE AT THE TEMPERATURE OF LIQUID NITROGEN. Claude Courpron, Robert Lochet, Yves Meyer, and Auguste Rousset (Faculté des Sciences, Bordeaux). *Compt. rend.* 250, 3549-51(1960) May 30. (In French)

The vibrational structure of the luminescence spectra of the deuterated derivatives of benzene, d_1 and d_2 -para, was compared with that of the d_0 and d_6 benzenes. By changing the rapidity of cooling of the dilute solutions of d_0 and d_6 in cyclohexane, two "sites" of the crystalline lattice of cyclohexane multiply in a different fashion. The relative intensity of the components of the doublets observed in absorption and in luminescence are thus caused to vary. (tr-auth)

19594

DISCONTINUITIES OF THE DIFFERENTIAL INVARIANTS OF THE TRAJECTORIES OF CHARGED PARTICLES. Henri Figueras. *Compt. rend.* 250, 3567-9(1960) May 30. (In French)

The results obtained previously (*Compt. rend.* 250, 2143 (1960)) for the differential invariants of the trajectory of a charged particle are applied to the study of the discontinuities of the same invariants when the particle crosses a surface of discontinuity of the derivatives of the electromagnetic field. (tr-auth)

19595

THE FORMATION OF EXCITONS IN AgBr BY THE PASSAGE OF AN IONIZING PARTICLE. Jacqueline Lory. *Compt. rend.* 250, 3622-3(1960) May 30. (In French)

The excitation phenomena produced in a crystal of AgBr by the passage of a charged particle should cause states of excitons to occur. The calculation of transitions thus produced indicates that this energy loss should be taken into consideration. (tr-auth)

19596

STUDY OF THE RESISTIVITY OF THE NITRIDES OF

CERIUM AND PRASEODYMIUM. Joseph N. Daou. *Compt. rend.* **250**, 3635-7(1960) May 30. (In French)

The study of the resistivity of the nitrides of cerium and praseodymium was made on samples prepared by the action of nitrogen on metal hydride foils. The methods of preparation of the hydrides and nitrides are described. The thermal variations of the ratio of the electrical resistance of CeN to that of Ce and the variations of the ratio of the electrical resistance of PrN to that of Pr were determined as a function of the degree of fixation of the nitrogen at 25°C. The results are graphed. CeN is a much better conductor than PrN. (J.S.R.)

19597

ELECTRONIC PROCESSES AND Z CENTRES IN NaCl AND KCl CRYSTALS. A. Bohun, J. Kantůrek, J. Trnka, and M. Lébl (Inst. of Technical Physics, Czechoslovak Academy of Sciences, Prague). *Czechoslov. J. Phys.* **10**, 349-59 (1960). (In English)

Experimental results are given of the study of colored "pure" and Ca doped NaCl and KCl crystals. The mechanisms of the formation of R centers by coagulation of F centers and of the formation of Z centers from F centers, cation vacancies, and Ca ions are discussed. An alternative model for Z₃ centers is proposed. The possible connections between physical and chemical behavior are indicated. (auth)

19598

THE EFFECT OF ANNEALING ON THERMOSTIMULATED PROCESSES OF COLOURED SODIUM CHLORIDE CRYSTALS. A. Bohun (Inst. of Technical Physics, Czechoslovak Academy of Sciences, Prague). *Czechoslov. J. Phys.* **10**, 360-5(1960). (In English)

After annealing samples of NaCl it was shown experimentally that the thermoluminescence in the high-temperature maxima not only increases, which is in agreement with the results of other authors, but that simultaneously the thermoemission decreases. This effect was probably caused by the formation of a surface layer during the evaporation of the sodium and both prevented the rise of the electrons from the crystal and the vacancies left in it by the sodium increased in concentration of the V centers and thus in the probability of luminescence. (auth)

19599

STUDY OF THE MAGNETIC RESONANCE FROM ATOMIC BEAMS BETWEEN EXCITED STATES OF CADMIUM AND ZINC ATOMS, AND CADMIUM II AND ZINC II IONS.

Edmond Geneux and Barbara Wanders-Vincenz (Université, Geneva). *Helv. Phys. Acta* **33**, 185-220(1960). (In French)

The magnetic dipole resonance method is applied to excited levels of Cd, Zn, Cd II, and Zn II in an atomic beam. The levels can be excited either by an optical method or by electron impact. The following quantities were determined: Atomic Cd: 5^3P_1 state; (a) ratio of Landé g factors for even and odd isotopes, (b) hyperfine structure constant of Cd¹¹¹, Cd¹¹³, (c) lifetime, (d) polarization percentage versus electron energy; 6^1D_2 state: lifetime; 4^3F_4 state: lifetime. Atomic Zn: 4^3P_1 state; polarization percentage versus electron energy; 5^1D_2 state: lifetime. Cd II: $4d^9 5s^2 2D_{3/2}$ state and Zn II: $3d^9 4s^2 2D_{3/2}$ state; (a) lifetime and (b) polarization percentage. This seems to be the first time that magnetic dipole resonance of nonmetastable excited states of free ions was observed. This work leads to some general considerations concerning the possibility of applying the magnetic dipole resonance method to atomic beams. (auth)

19600

MULTIPLE EMISSION SPECTRA OF TRIVALENT EUROPIUM IN THE SCHEELITE STRUCTURE. L. G. Van Uitert

and R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). *J. Chem. Phys.* **32**, 1687-9(1960) June.

Spectra resulting from emission from four electronic levels are observed for members of the series $Ca_{1-2x}Na_xEu_xWO_4$. Their relative intensities are concentration dependent. Successively lower lying emission levels are quenched by what appear to be exchange interactions resulting from coupling between two or more neighboring Eu^{3+} ions. (auth)

19601

EFFECT OF PRESSURE ON COLOR CENTERS IN Ag^+ -DOPED ALKALI HALIDES. R. A. Eppler and H. G. Drickamer (Univ. of Illinois, Urbana). *J. Chem. Phys.* **32**, 1734-8(1960) June.

The effect of pressure on various color centers in silver-doped alkali halides was studied. The crystals include NaCl (two concentrations), KCl, and KBr. The resulting shifts are used to confirm the assignments of some peaks, and in certain cases to decide among conflicting interpretations. (auth)

19602

INTER- AND INTRAMOLECULAR POTENTIALS AND THE SPECTRUM OF ICE. C. Haas and D. F. Hornig (Princeton Univ., N. J.). *J. Chem. Phys.* **32**, 1763-9(1960) June.

Whereas the spectra of H_2O and D_2O ice cannot yet be explained unambiguously, the spectra of HDO in dilute solution in either H_2O or D_2O may be interpreted readily. In particular, since ν_{OH} occurs at 3275 cm^{-1} and $2\nu_{OH}$ at 6300 cm^{-1} , nearly the harmonic value, the barrier to proton transfer lies well above the latter level and must exceed 23 kcal/mole. The width of ν_{OD} at 2416 cm^{-1} is only 20 cm^{-1} , whereas that of ν_{OH} is about 80 cm^{-1} and $2\nu_{OH}$ about 600 cm^{-1} . These widths can be explained by proton tunneling if the barrier height is near 32 kcal, in which case the second minimum must lie below the level ν_{OH} . It must therefore be less than 14 kcal/mole above the primary minimum. A doubling of ν_{OD} from OD...OD pairs was also observed and the magnitude of the splitting is consistent with an effective charge of 0.6e on the protons. It is clear from these results that the usual width of hydrogen bonded OH lines is not an intrinsic characteristic of the O-H...O bond but results largely from intramolecular coupling of the O-H motions. (auth)

19603

LATTICE VIBRATIONS IN ALKALI HALIDE CRYSTALS. II. POTASSIUM AND RUBIDIUM HALIDES; CESIUM FLUORIDE. Arnold M. Karo (Univ. of California, Livermore). *J. Chem. Phys.* **33**, 7-20(1960) July.

Vibrational frequency distributions for the potassium and rubidium halides and for cesium fluoride were evaluated on the basis of the Born lattice theory by the use of Blackman's numerical sampling method. Both room-temperature and extrapolated 0°K parameters were used in the calculation. Specific heats, the corresponding Debye characteristic temperatures, and the moments of the distributions were obtained directly from the frequencies. Comparison is made with experimental data and with other theoretical work. (auth)

19604

THERMODYNAMIC PROPERTIES OF UNIPosITIVE GASEOUS ELEMENTAL IONS. John W. Green, Duncan E. Poland, and John L. Margrave (Univ. of Wisconsin, Madison). *J. Chem. Phys.* **33**, 35-9(1960) July.

Thermodynamic properties of unipositive gaseous elemental ions were calculated from available energy level data for a range of temperatures from 100 to 50,000°K. (auth)

19605

ABSORPTION SPECTRA OF SOLID XENON, KRYPTON, AND ARGON IN THE VACUUM ULTRAVIOLET.

O. Schnepf and K. Dressler (National Bureau of Standards, Washington, D. C.). *J. Chem. Phys.* **33**, 49-55(1960) July.

The absorption spectra of solid xenon, krypton, and argon at 4.2°K were investigated between 3500 and 1200 Å. In the region between 1510 and 1200 Å solid xenon has four absorption bands, three of which lie within less than 800 cm^{-1} of atomic transitions, all being shifted to lower energy in the solid. Solid krypton has two bands between 1250 and 1200 Å which lie within 900 cm^{-1} of atomic transitions but are shifted to higher energy in the solid. No absorption was found in solid argon at wavelengths longer than 1200 Å. The experimental results are interpreted and discussed on the basis of valence type interatomic interactions in the excited states. It is predicted that the fluorescence spectra of these solids would be displaced to lower energy by about 1 eV. (auth)

19606

IONIZATION OF Cu, Ag, AND Au BY ELECTRON IMPACT.

Normand C. Blais and Joseph B. Mann (Los Alamos Scientific Lab., N. Mex.). *J. Chem. Phys.* **33**, 100-5(1960) July.

The relative ionization probabilities of copper, silver, and gold by electron impact were studied near threshold. Nearly monoenergetic electrons, obtained by means of the retarding potential difference method, were employed. Narrow peaks were found superimposed on the ion yield that arose from transition to the ion ground state. It was possible to correlate these peaks with groups of energy levels, many of which are known to autoionize. The ionization probability curve for formation of doubly ionized gold was also obtained and found to be a sum of linear functions of the electron excess energy. The onset of each linear section indicated the presence of an excited state of Au III. Three energy levels were located at 2.2₆, 3.9₂, and 7.8₁ eV above the ground state. (auth)

19607

MOLECULAR COLLISION CROSS SECTIONS FROM INFRARED ABSORPTION MEASUREMENTS. Harold Babrov, George Ameer, and William Benesch (Univ. of Pittsburgh). *J. Chem. Phys.* **33**, 145-50(1960) July.

Through measurement of the equivalent width (fractional integrated absorption) of collision-broadened lines of the P branch of the HCl fundamental vibration-rotation band at 3.5 μ , the Lorentz half-widths of these lines were determined and optical collision cross sections deduced therefrom. The cross sections obtained were those for collisions between HCl molecules and Ar, CO₂, CO, D₂, H₂, HBr, He, Ne, N₂, O₂, as well as other molecules of HCl. One of the more interesting aspects of these cross sections was their dependence on the rotational state of the absorbing molecule and the various forms which this J dependence took for the different foreign gases. The line widths ranged between the extremes of 0.233 and 0.0111 $\text{cm}^{-1} \text{atmos}^{-1}$ while the collision cross sections ranged between 3.04×10^{-14} and $0.091 \times 10^{-14} \text{cm}^2$. Also reported were recently measured values of the strengths for the first eight lines of the P branch of the HCl fundamental. The strength of this band based on these measurements, was found to be $143 \pm 5 \text{cm}^{-2} \text{atmos}^{-1}$ at 300°K. (auth)

19608

ELECTRONIC TRANSITIONS OF RARE EARTH IONS IN THE INFRARED REGION. G. Mandel, R. P. Bauman, and

E. Banks (Polytechnic Inst., Brooklyn). *J. Chem. Phys.* **33**, 192-3(1960) July.

The $^2F_{7/2} \leftarrow ^2F_{5/2}$ transition of the cerous ion was observed in solid solutions of cerium(III) fluoride in cadmium fluoride. The band center is at about 2250 cm^{-1} , in good agreement with the free-ion value of 2253.0 cm^{-1} . The crystal field splitting of the band appears to be enhanced by the effect of the interstitial fluoride ions which compensate for the excess positive charge of Ce^{3+} in Cd^{2+} positions. Addition of NaF, which eliminates the interstitial fluoride ions, decreases the splitting. Praseodymium and neodymium ions in CdF_2 also showed absorption bands. (auth)

19609

MULTIPLE IONIZATION IN ARGON AND KRYPTON BY ELECTRON IMPACT. R. E. Fox (Westinghouse Research Labs., Pittsburgh). *J. Chem. Phys.* **33**, 200-5(1960) July.

The formation of multiply charged ions by electron impact in argon and krypton was studied with a mass spectrometer. The behavior of the ionization cross section as a function of electron energy was investigated for electron energies up to 600 eV. The ionization potentials in eV were determined to be as follows: Kr^{2+} 38.45 ± 0.1 , Kr^{3+} 75.6 ± 0.5 , Kr^{4+} 146.6 ± 2 , Kr^{5+} 217.5 ± 10 , Kr^{6+} 350 ± 10 , Ar^{2+} 43.4 ± 0.3 , Ar^{3+} 84.8 ± 0.5 , Ar^{4+} 150.0 ± 5 . The shapes of the ionization curves near threshold were studied and discussed in terms of the threshold law for ionization. The maximum cross sections for each multiply charged ion was determined relative to that of the singly charged ion and compared to data obtained by previous investigators. (auth)

19610

NEAR-INFRARED ABSORPTION SPECTRA OF ORTHO- AND PARA-H₂O IN SOLID XENON AND ARGON. Jay A. Glasel (Univ. of Chicago). *J. Chem. Phys.* **33**, 252-5(1960) July.

The near-infrared absorption spectra of H₂O trapped in solid argon and xenon were studied at 20°K. The spectra, taken at concentrations of H₂O to matrix of 1:600, exhibit structure which is analyzed in terms of the known rotational and vibrational constants of the H₂O molecule. The results show that in solid xenon and argon matrices, the monomer H₂O exists as two modifications, one of which is rotating in its ground vibrational state. The theoretical intensities for the spectral bands of H₂O gas at 20°K are calculated and shown to agree with the bands observed in H₂O-xenon. The changes in the observed intensities for other matrices are discussed. The changes in the spectra of the films when they are warmed to 35°K are shown and discussed. (auth)

19611

EFFECT OF PRESSURE ON THE M CENTER IN ALKALI HALIDE CRYSTALS. S. Minomura and H. G. Drickamer (Univ. of Illinois, Urbana). *J. Chem. Phys.* **33**, 290-3(1960) July.

The effect of pressure to 52,800 atm was measured on the M band in NaCl, KCl, KBr, and KI, and on the R₂ and N bands in KCl. In general, the band peak shifted to higher frequency with increasing pressure for all bands. At the phase transition from fcc to sc there was a blue shift in KCl, but a red shift in KBr and KI. The shift could correspond to a balance between contraction and polarizability effects. From an Ivey-type relation, it would seem that the M center was somewhat less compressible than the F center. There was a marked increase in intensity of the M center in the potassium halides in going through the phase transition from the fcc to the sc lattice. (auth)

19612

EFFECT OF DEUTERIUM SUBSTITUTION ON THE LIFETIME OF THE PHOSPHORESCENT TRIPLET STATE OF NAPHTHALENE. H. Sternlicht and H. M. McConnell (California Inst. of Tech., Pasadena). J. Chem. Phys. **33**, 302-3(1960) July.

The replacement of protons by deuterons in naphthalene increased the phosphorescence lifetime from 2.1 to 16.9 sec. The suggestion that the isotope effect might arise from nuclear hyperfine interactions was considered. Observed independence of phosphorescence lifetime on molecular orientation in the magnetic field did not eliminate that effect. (M.C.G.)

19613

MAGNETOHYDRODYNAMIC FLOW OF A VISCOUS FLUID PAST A SPHERE. Richard Van Blerkom (International Business Machines Corp., [Oswego, N. Y.]). J. Fluid Mech. **8**, 432-41(1960) July.

The flow of a viscous incompressible electrically conducting fluid past a sphere is studied; the uniform ambient flow field is colinear with the ambient uniform magnetic field. The force exerted on the sphere is computed for various conductivities and Reynolds numbers; of particular interest is the distinction in behavior between the flow with ambient particle speed greater than ambient Alfvén speed and that with particle speed less than Alfvén speed. (auth)

19614

EXACT SOLUTIONS OF THE MAGNETOHYDRODYNAMIC EQUATIONS. W. E. Williams (Liverpool Univ.). J. Fluid Mech. **8**, 452-64(1960) July.

Exact one-dimensional solutions of the magnetohydrodynamic equations of an incompressible fluid are considered. It is shown that one class of plane wave solutions of the linearized equations is also a possible class of solutions of the general equations including the effect of displacement current. A similar result is also established for the solutions for a horizontally stratified fluid. For the particular case when the viscosity is equal to the magnetic diffusivity an exact solution is obtained for the magnetohydrodynamic Rayleigh problem for a semi-infinite plate. It is shown that this solution may be employed directly to give the solution for liquids of small, but not necessarily equal, viscosity and magnetic diffusivity. (auth)

19615

ON THE MANY-PARTICLE STRUCTURE OF GREEN'S FUNCTIONS IN QUANTUM FIELD THEORY. K. Symanzik (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. **1**, 249-73(1960) July-Aug.

The structure of the expectation values of retarded multiple commutators (r functions) is analyzed in terms of the number of particles in the decomposition of absorptive parts. As to the one-particle structure, it is found that an r function is a sum of a finite number of terms, each of them except one (that one being called one-particle irreducible) being in momentum space a product of one-particle irreducible factors, linked by one-particle propagation functions. As to the two-particle structure, it is found that a one-particle irreducible function is the solution of an inhomogeneous Bethe-Salpeter equation, whose kernel and inhomogeneous term both are two-particle irreducible functions. This structure, which could be generalized to higher particle numbers, closely resembles perturbation theory but is here derived from locality and the asymptotic condition alone by converting the nonlinear system of integral equations for r functions stepwise into one in which neither one- or two-particle reducible functions, nor one- or two-particle intermediate states appear. The implica-

tion of such structure analysis for an interpretation of perturbation theory, improvements of present methods to derive analytic properties of scattering amplitudes, and a formalism with unstable particles are discussed, and the strength of singularities of various functions investigated. (auth)

19616

EXCITATION OF IRREGULAR WAVEGUIDES. A. G. Sveshnikov (Lomonosov Moscow State Univ.). Nauch. Doklady Vyssheĭ Shkoly. Fiz.-Mat. Nauki No. 2, 162-5 (1959). (In Russian)

Waveguides with variable cross sections require proper functions at each step of integration. Waveguide equations somewhat different from the above and more convenient for numerical solutions are suggested. A problem of excitation in a homogeneously filled irregular waveguide with a side surface Σ , differing from a regular cylindrical but ideally conducting surface, is used as an example. The expression obtained is suitable for computer programming and can also be applied to cases of nonuniformly filled waveguides and waveguides with absorbing walls. (R.V.J.)

19617

ENERGY LOSS OF HEAVY IONS IN NICKEL, OXYGEN, AND NUCLEAR EMULSION. P. G. Roll and F. E. Steigert (Yale Univ., New Haven). Nuclear Phys. **17**, 54-66(1960) June (2). (In English)

Range-energy relations for He^4 , B^{10} , B^{11} , C^{12} , N^{14} , O^{16} , F^{19} , and Ne^{20} ions in oxygen and nickel were measured in the energy range 2 to 10 Mev per amu. Together with similar relations for heavy ions in nuclear emulsions, these were differentiated numerically to obtain specific energy loss relations. The effective charge of heavy ions passing through matter, as well as the relative stopping power per atom of oxygen, nickel and emulsion, were computed from these and compared with theoretical predictions. From this comparison, it is concluded that fairly reliable calculations of specific energy losses and/or range-energy relations can be made for various heavy ion species in different stopping media. (auth)

19618

NEUTRON SPECTROSCOPY WITH NUCLEAR EXPLOSIONS. Donald J. Hughes (Brookhaven National Lab., Upton, N. Y.). Nucleonics **18**, No. 7, 54-8(1960) July.

The possibilities of using nuclear explosions, particularly underground, for neutron spectroscopy are explored and found to be good. For example, a single explosion would give bursts on the order of 10^{24} neutrons, which is equivalent to $\sim 3,000$ years of operation for any of the usual neutron sources giving $\sim 3 \times 10^{20}$ neutrons per year. Fluxes of $\sim 4 \times 10^{10}$ neutrons/cm² would be obtained in one explosion in a 1-ev energy interval at the 10-ev level, as compared with 10^1 neutrons/cm² in the same interval calculated for the fast chopper at the NRU Reactor operating all the time for a full year. Such fluxes would greatly extend the resolution of neutron spectroscopy measurements and make possible further study of unresolved energy levels, e.g., those of iridium above 100 ev. Another area that would greatly benefit from such high fluxes is the complete analysis of U^{233} , U^{235} , and Pu^{239} in the resonance region: total cross section, fission cross section, fission fragments, etc. The short scale of time means that such storage devices as ferrite cores, magnetic drums, and electrostatic tubes must be used in place of channel time analyzers for the recording of data. Certain types of experiments, e.g., coincidence measurements, cannot be made with explosions as neutron sources in the same way as with conventional sources, but most of them can be modified so as to be possible. (D.L.C.)

19619

RELATIVISTIC OBSERVATIONS AND THE CLOCK PROBLEM. J. Terrell (Los Alamos Scientific Lab., N. Mex.). *Nuovo cimento* (10) **16**, 457-68(1960) May 1. (In English)

Relativistic observational data are discussed with the purpose of clarifying some aspects of the clock problem, usually called the clock paradox or twin paradox. Einstein's position, that an ideal clock which moves in a closed curve with respect to an unaccelerated clock will indicate the passage of less time, is supported. It is pointed out that the sets of observational data of two observers who take the place of the clocks in the above situation will not be at all similar. Furthermore, the data of the accelerated observer, obtained by means of single Doppler shift and visual observational methods, will be highly implausible and inconsistent with data obtained by radar and double Doppler shift methods. Thus the accelerated observer will be under no temptation to consider himself in a situation equivalent with that of the unaccelerated observer, and should not be surprised to discover upon returning that he has aged less than the other observer. It is pointed out that the accelerated observer will see striking effects due to relativistic aberration which will not be seen by the other observer, but that neither observer will be able to see or photograph the Lorentz contraction. Only the special theory of relativity is necessary in these calculations, since no genuine gravitational fields, produced by massive bodies, are involved. (auth)

19620

VAPOUR PRESSURE OF ISOTOPIC LIQUIDS. II. Ne AND A ABOVE BOILING-POINT. G. Boato, G. Casanova, and M. E. Vallauri (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). *Nuovo cimento* (10) **16**, 505-19(1960) May 1. (In English)

In order to extend previous studies of vapor pressure of isotopic liquids in a wider temperature range, a new cryostat was built. The single stage separation factor α of the isotopic pairs $\text{Ar}^{36}-\text{Ar}^{40}$ and $\text{Ne}^{20}-\text{Ne}^{22}$ was measured up to a vapor pressure of 12 atmospheres using natural isotopic mixtures. The logarithm of the vapor pressure ratio of the pure isotopes was derived from α and found to be linearly dependent on $1/T$: $\ln(p_{36}/p_{40}) = 1.31(1/T) - 8.95 \times 10^{-3}$ for argon from 83 to 120°K, and $\ln(p_{20}/p_{22}) = 2.510(1/T) - 5.673 \times 10^{-2}$ for neon from 25 to 40°K. A brief discussion of the results is given. (auth)

19621

EFFECTS OF DEVELOPMENT ON THE TRANSVERSE DIMENSION OF HEAVY-ION TRACKS IN IONOGRAPHIC EMULSIONS. Ch. Gegauff and J. P. Lonchamp (Laboratoire de Physique Corpusculaire, Strasbourg). *Nuovo cimento* (10) **16**, 520-31(1960) May 1. (In French)

The effects of various developers on the transverse dimensions of ion tracks of He, C, N, O, Ne, and Ar in ionographic emulsions G-5, C-2, and L-4 were studied. The discrimination of heavy-ion tracks by their transverse dimension is dependent on this effect which is very great for ordinary developers (amido, ID 19). A development regulation by measurement of the width of α tracks is proposed. The difficulty of using a simple correction factor which accounts for the effects of development is pointed out. (tr-auth)

19622

SCATTERING OF THERMAL ENERGY IONS IN SUPERFLUID LIQUID He BY PHONONS AND He^3 ATOMS. Lothar Meyer and F. Reif (Univ. of Chicago). *Phys. Rev. Letters* **5**, 1-3(1960) July 1.

Previous work was reported in which ions, produced in

liquid He by ionization with α particles, are designed to be used to study the properties of a superfluid. The ion mobility below 0.8°K suggests that the scattering of the ions occurs by phonon excitations of the fluid and by the He^3 atoms present. Experiments on purified helium led to ion mobilities substantially the same as for ordinary helium. The results are discussed for experiments in helium to which known amounts of pure He^3 were added. (B.O.G.)

19623

GIANT FLUCTUATIONS IN A DEGENERATE FERMI GAS. Walter Kohn and Stephen J. Nettel (Univ. of California, La Jolla). *Phys. Rev. Letters* **5**, 8-9(1960) July 1.

It was suggested that the ground state of an interacting gas of fermions has giant density or spin-density fluctuations and that the Hartree and Hartree-Fock equations of a one-dimensional gas have solutions which give lower energies than customary plane wave solutions. Arguments are set forth for the view that for sufficiently weak interactions the Hartree (and Hartree-Fock) ground states in two or more dimensions are the familiar plane wave states. It is concluded that for weak interactions the Hartree equations have a nontrivial ground state only in one dimension. There is little doubt that this is also true for the Hartree-Fock equation. (B.O.G.)

19624

DIRECT MEASUREMENT OF THE ELECTRON DENSITY AT THE NUCLEUS IN METALLIC LITHIUM AT LIQUID HELIUM TEMPERATURE. Ch. Ryter (Centre d'Etudes Nucléaires, Saclay, France). *Phys. Rev. Letters* **5**, 10-11(1960) July 1.

The nuclear polarization and electron spin resonance shift were observed in irradiated crystals of lithium fluoride at a frequency of 9340 Mc/sec and at 4.2 to 1.5°K. A formula is given which relates the ESR shift to the nuclear magnetization, which in turn is related to the electronic density. This value was found to be 0.442 ± 0.015 , which compares favorably with theoretical and experimental values. (B.O.G.)

19625

SOME RECENT PROGRESS IN STATISTICAL MECHANICS. George E. Uhlenbeck (Univ. of Michigan, Ann Arbor). *Phys. Today* **13**, No. 7, 16-21(1960) July.

A review of recent advances in statistical mechanics is given in relatively simple terms. The topics discussed are the ideal Bose gas, hard-sphere nonideal Bose gas, differences between Bose and Fermi gases, superfluids, irreversible processes, Gibbs' concept of irreversibility contrasted with Boltzmann's concept, and Bogoliubov's equations. (D.L.C.)

19626

SCINTILLATION TIME OF ORGANIC SCINTILLATORS IN NANOSECOND REGION. N. Vylkov (Joint Inst. of Nuclear Research, Dubna, USSR). *Pribory i Tekh. Ekspt.* No. 1, 30-4(1960) Jan.-Feb. (In Russian)

A measuring method is offered for determining the scintillation time of organic scintillators by comparison to the time of electron flight through photo-multipliers. The excitation of specimens is achieved with Co^{60} γ quanta. Measurements of the scintillation time of stilbene, tolane, p-terphenyl solution in phenylcyclohexane, and two plastic scintillators show scintillation time variations from 5.6 up to 11.8 nsec. (tr-auth)

19627

PLASTIC SCINTILLATORS WITH 1, 2-DIARYL ETHYLENE ADMIXTURES. L. L. Nagornaya, A. P. Klimov, L. Ya.

Maleks, L. A. Shubina, and A. I. Timchenko (Khar'kov Branch of the All-Union Scientific-Research Inst. of Chemical Reagents). *Pribery i Tekh. Ekspt.* No. 1, 34-6(1960) Jan.-Feb. (In Russian)

Luminescence and scintillation properties of 1-(methoxyphenyl)-2-phenylethylene; 1-(4-chlorophenyl)-2-phenylethylene, and 1-phenyl-2-(4-biphenyl)ethylene solutions in polystyrene are studied. The scintillation efficiency of 1% solution of 1-phenyl-2-(4-biphenyl)ethylene reaches 147% in comparison to 2% p-terphenyl. The scintillation efficiency of diarylethenes is proportional to photoluminescence. (tr-auth)

19628

THE INFLUENCE OF INITIAL LUMINESCENCE ADMIXTURE ON THE EFFICIENCY OF PLASTIC SCINTILLATORS WITH SPECTRUM SHIFTING. A. P. Killmov and L. L. Nagornaya (Khar'kov Branch of the Scientific-Research Inst. of Chemical Reagents). *Pribery i Tekh. Ekspt.* No. 1, 37-9(1960) Jan.-Feb. (In Russian)

Luminescence spectra and scintillation efficiency in γ excitation of plastic scintillators were measured. The conditions of energy transfer from the initial admixture to the shifter do not depend on the chemical character of the substance, but are determined by their optical characteristics. (tr-auth)

19629

CONCERNING THE EMISSION OF AN ELASTIC WAVE FROM A SPHERICAL UNDERGROUND EXPLOSION.

N. V. Zvolinskii. *Priklad. Mat. i Mekhan.* 24, 126-33(1960) N.-Feb. (In Russian)

The flow of a plastic medium into an incompressible state under the influence of an explosion is investigated. The propagation of the detonating wave and the release of the elastic wave are examined. Spherical symmetry is assumed while the work involved in the transformation of the plastic state into an incompressible condition is taken to be proportional to the change in the maximum displacement. The detonating wave propagation is pictured as occurring in four stages. First, the shock wave propagates itself through the undisturbed medium. Next, the elastic wave is propagated through the undisturbed medium; followed by a zone of packing. Third, plastic flow continues but the packing of the medium stops. Finally, as the zone of packing is stopped the rear of the elastic wave is severed from it and the elastic wave goes off to infinity. Each of the stages is discussed but numerical calculations are not presented. The kinematic propagation is illustrated qualitatively by a diagram. (TTT)

19630

CONCERNING WAVES CREATED ON THE SURFACE OF AN INCOMPRESSIBLE LIQUID BY A SHOCK WAVE. B. N. Rumyantsev. *Priklad. Mat. i Mekhan.* 24, 240-8(1960) Mar.-Apr. (In Russian)

Planar and three-dimensional problems associated with the motion of an incompressible liquid as pressure is applied to its surface are examined. The influence of gravity is disregarded. The problem is visualized as follows. An explosion occurs above the liquid's surface and after a time the shock wave reaches the liquid and interacts with it. To determine the movements of the liquid and gas, the problem has to be solved jointly in both phases. However, to a first approximation, it is assumed that the motion of the liquid does not influence that of the gas. The motion of the gas is taken to be known. The planar problem is solved for three instances: (1) the shock wave pressure is constant, (2) the pressure is an arbitrary function of x/t (where " x " is the abscissa and " t " the time), and (3) the

explosion over the liquid has cylindrical symmetry. The three-dimensional problem is solved for two particular cases: (1) where a circular zone of constant pressure expands in all directions at a constant velocity and (2) where half of the explosion energy is absorbed into the gaseous phase. (TTT)

19631

THE DISSOCIATION OF FAST H_2^+ IONS BY HYDROGEN.

D. R. Sweetman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). *Proc. Roy. Soc. (London)* A256, 416-26(1960) July 5.

H_2^+ ions of energy 100 to 800 kev were passed through hydrogen gas and the cross sections for the following four processes determined: (1) $H_2^+ \rightarrow H^+ + H^0$, (2) $H_2^+ \rightarrow H^+ + H^+$, (3) $H_2^+ \rightarrow H^0 + H^0$, (4) $H_2^+ \rightarrow H_2^0$. A magnetic field was used to separate the fast dissociation products of different e/m , and CsI(Tl) scintillation crystals were used as detectors. Double-height pulses resulted when two particles of the same e/m simultaneously entered one of the crystals and were clearly resolved from single pulses. Processes (3) and (4) were separated by moving a fine slit across the neutral-particle counter which thus counted only H_2^0 particles as double pulses. The partial cross sections for processes (1) and (2) show an E^{-1} dependence at high energies. The energy dependence is less marked below 300 kev, where the Born approximation might be expected to be invalid. The partial cross sections for processes (3) and (4) show the strong energy dependence characteristic of an electron-exchange process. The angular distribution for process (3) is consistent with the reaction proceeding via the $1^3\Sigma_u$ repulsive triplet state. The large fraction of the capture reactions proceeding this way (70%) is reasonable considering the high probability of formation in the triplet state. The large values of the cross sections for processes other than simple dissociation account, in part, for the considerable discrepancies between the results of other workers. (auth)

19632

THE MOBILITIES OF IONS IN MOLECULAR GASES.

A. M. Arthurs and A. Dalgarno (Queen's Univ., Belfast). *Proc. Roy. Soc. (London)* A256, 552-8(1960) July 19.

A formula was derived for the mobility of an ion in a diatomic molecular gas and quantitative results obtained for mobilities in the limit of vanishing temperature. As an example of the detailed application of the theory, calculation was made of ion mobilities in molecular hydrogen and molecular deuterium, for which it was necessary to take account of the rotational distributions. In contrast to atomic gases for which the low-temperature mobilities are independent of temperature, in molecular gases the low-temperature mobilities decreased as the temperature decreased, ultimately passing through a minimum at some very low temperature. (auth)

19633

ON THE VIBRATION OF DISORDERED LINEAR LATTICE.

[PART] III. Jun-ichi Hori (Hokkaido Univ., Sapporo). *Progr. Theoret. Phys. (Kyoto)* 23, 475-89(1960) Mar. (In English)

The eigenfrequency spectrum of an isotopic two-component disordered lattice was calculated approximately by a method which requires only a comparatively small amount of numerical work. An argument based on perturbation theory shows formally that the spectrum of a completely random lattice is the same as that of a virtual regular lattice composed of atoms with average mass, except at the edge and outside the band. The validity of this statement was investigated and the result is that the

smaller the concentration of lighter atoms, the larger the frequency domain in which the spectrum can be regarded as approximately the same as that of a virtual regular lattice. The spectrum in the neighborhood of the edge of the band where the above statement does not hold was calculated by applying the moment-trace method only to that region. The result is that when the concentration of lighter atoms is comparable with or larger than that of heavier atoms, there is only one presumably rounded maximum at the position of the band-edge of a virtual regular lattice, whereas when the number of lighter atoms becomes smaller, there appears an impurity band, its separation from the main band becoming more distinct as the concentration of lighter atoms gets smaller. Both results are natural provided the spectrum is to approach that of a Poisson lattice as the lighter atoms become fewer in number. (auth)

19634

INVESTIGATION OF CENTER CAPTURE IN ALKALI-HALIDE PHOSPHOR CRYSTALS. Ch. B. Lushchik. Trudy Inst. Fiz. i Astron. Akad. Nauk Eston. S.S.R. No. 3, 1-230 (1955). (In Russian)

The principle inertia characteristics of crystal phosphors and methods of investigation are analyzed. The spectra of local levels of capture and distribution of electrons and holes at the capture levels are studied by thermal scintillation and decolorization. Participation of thermal microdefects, admixture defects, and activator ions as capture centers for electrons and holes is investigated as well as the mechanism of recombination and kinetics of post-scintillation in alkali-halide phosphors. 271 references. (R.V.J.)

19635

EFFECT OF TEMPERATURE ON CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN IRON. I. B. Borovskii, A. N. Kabanov, Yu. M. Kushnir, and V. V. Shmidt (Metallurgical Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 1383-7(1960) May. (In Russian)

During a phase transition of the first kind ($\alpha \rightarrow \gamma$ -transition) a discontinuity was observed in the characteristic energy losses of electrons in iron. The phenomenon is treated from the viewpoint of the plasma model. (auth)

19636

THOMAS-FERMI ATOMIC MODEL WITH QUANTUM AND EXCHANGE CORRECTIONS. N. N. Kalitkin. Zhur. Eksptl'. i Teoret. Fiz. 38, 1534-40(1960) May. (In Russian)

Quantum and exchange corrections to the energy and chemical potential of the Thomas-Fermi atom are derived and numerical calculations of thermodynamical functions for a cold atom are presented. Extrapolation of the model to the region of normal densities is considered. The calculations are compared with the experimental data. (auth)

19637

ON MOTION OF A PISTON IN A CONDUCTING MEDIUM. R. V. Polovin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian, SSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 1544-55(1960) May. (In Russian)

Magnetohydrodynamic waves are considered which arise when a piston moves in a perfectly conducting medium in the presence of a magnetic field. If the transverse velocity component of the piston exceeds the velocity of sound in the unperturbed medium a magnetic field is generated. In this case the magnetic pressure becomes comparable with the hydrostatic pressure. At supersonic velocities a vacuum is formed between the piston and

medium (cavitation). Compared to ordinary hydrodynamics additional cases of cavitation appear in the movement of the piston with supersonic velocity in the direction perpendicular to the normal and also when the piston advances, if the angle between its velocity vector and the normal to its surface exceeds 70° (for an ideal gas with $\gamma = 5/3$). Increase of the piston velocity component perpendicular to the normal decreases the drag. When cavitation occurs the drag is four times smaller than in the case of motion of the piston along the normal to its surface. (auth)

19638

THE FARADAY EFFECT IN YTTRIUM GARNET AT INFRARED FREQUENCIES. G. S. Krinchik and M. V. Chetkin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 38, 1643-4(1960) May. (In Russian)

The Faraday effect in yttrium ferrite garnet $Y_3Fe_5O_{12}$ was measured in the infrared region at wave lengths from 0.94 to 9μ (the region where the absorption processes induced by lattice vibration begin and light absorption processes related to electron transitions stop). (R.V.J.)

19639

ACHROMATIC MAGNETIC MIRRORS. V. M. Kelman, S. Ya. Yavor, and T. Ya. Fishkova (Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz. 30, 129-37(1960) Feb. (In Russian)

Descriptions are presented of magnetic achromatic mirrors with two-dimensional fields and with antisymmetry planes at 45° , 40.7° , 30° , and 27.6° . Calculations are made of their plane and spatial trajectories. (tr-auth)

19640

THE INVESTIGATION OF PARABOLOID MAGNETIC LENS FOCUSING PROPERTIES. P. I. Strelnikov and A. I. Fedorenko (Inst. of Physics and Tech., Academy of Sciences, Kharkov). Zhur. Tekh. Fiz. 30, 138-41(1960) Feb. (In Russian)

The possibility of compensating the separating action of space charge in an electron beam by means of a parabolic magnetic field was investigated. Under optimum focusing conditions the electron beam can be contracted to 1 mm in diameter, achieving current voltage to 0.8 a/mm^2 . It is shown that the beam can not only be converging but also parallel and diverging. (R.V.J.)

19641

OPTICAL PROPERTIES OF AXIALLY SYMMETRICAL MAGNETIC FIELDS WITH THE CENTRAL SOURCE OF CHARGED PARTICLES. S. A. Kuchaï. Zhur. Tekh. Fiz. 30, 142-52(1960) Feb. (In Russian)

Axially symmetric fields with central sources are used for isotopic separation of wide-angle and high-intensity beams of charged particles. (tr-auth)

19642

THE VERTICAL FOCUSING OF THE ELECTRON BEAM BY MEANS OF CYLINDRICAL MAGNETIC LENSES IN THE AXIALLY-SYMMETRICAL MAGNETIC FIELD INCREASING RADially. V. M. Kelman, B. P. Perehud, K. A. Dolmatova, and I. D. Lusanin (Inst. of Physics and Tech., Academy of Sciences, Leningrad). Zhur. Tekh. Fiz. 30, 153-8(1960) Feb. (In Russian)

Previously it was postulated that vertical focusing of electrons moving in a magnetic field along curves close to the circumference or spiral can be achieved by means of cylindrical magnetic lenses. The focusing can be used in charged particle accelerators in which the leading magnetic field increases with increased radial distances. Experimental investigations of electron motion in magnetic fields where the defocusing action of the field is suppressed by cylindrical magnetic lenses are described. (R.V.J.)

19643

VOLUME CHARGE OSCILLATION IN QUASICOMPENSATED ION BEAMS. M. V. Nezlin. *Zhur. Tekh. Fiz.* **30**, 168-77(1960) Feb. (In Russian)

Volume charge compensation in an intense ion beam passing through a discharged gas in a strong magnetic field was studied. The oscillation mechanism which induces strong volume charge decompensation in beams with electric fields reaching several tens of volts per centimeter was investigated. (tr-auth)

19644

ANODE REGION IN GAS DISCHARGE AT LOW PRESSURE. III. THE APPEARANCE OF SUPPLEMENTARY PLASMAS ON ANODE. B. N. Klarfeld and N. A. Neretina (All Union Electro-Technical Inst., Moscow). *Zhur. Tekh. Fiz.* **30**, 186-9(1960) Feb. (In Russian)

The appearance of spots on the discharge anode in mercury, inert gases, and hydrogen vapors was studied. The properties of the spot itself were investigated by introducing a probe into the spot. The regular pattern of spots in the anode results from the reverse action of each spot on the surrounding discharge region. (R.V.J.)

19645

THE MOTION OF CHARGED PARTICLES IN A SPACE-PERIODIC MAGNETIC FIELD. K. D. Sinelnikov, B. N. Rutkevich, and V. D. Fedortchenko (Inst. of Physics and Tech., Kharkov). *Zhur. Tekh. Fiz.* **30**, 249-55(1960) Mar. (In Russian)

Under certain conditions even slight magnetic field modulation induces nonadiabatic motion of charged particles, which in turn leads to magnetic-trap confinement of particles entering through the external field. An analysis is made of single-particle motion in a space-modulated field; special attention is paid to the non-linearity of the equations of motion. The problem is solved by asymptotic methods, assuming small field modulation. (tr-auth)

19646

THE MOTION OF PARTICLES IN A SCREW-SHAPED TOROIDAL MAGNETIC FIELD. A. I. Morosov and L. S. Solov'ev. *Zhur. Tekh. Fiz.* **30**, 271-82(1960) Mar. (In Russian)

A longitudinal invariant generalization was derived for screw-shaped magnetic fields and the motion of particles in such a field is analyzed. Studies are also made of the particle motion in "figure-eight" fields. (tr-auth)

19647

THE NON-STATIONARY FLOW OF CONDUCTING LIQUID IN A FLAT PIPE IN PRESENCE OF CROSSING MAGNETIC FIELD. I. B. Chekmarev (Kalinin Leningrad Polytechnic Inst.). *Zhur. Tekh. Fiz.* **30**, 338-44(1960) Mar. (In Russian)

Non-stationary flow of viscous incompressible conducting liquid in a plane infinitely long tube with a transverse magnetic field was investigated. Formulas for the velocity and electric and magnetic field intensities at arbitrary liquid and tube wall conductivities are derived by means of Laplace transforms. The complex integrals in the solution are calculated for the case of ideally conducting walls. (tr-auth)

19648

THE SAG OF THE POTENTIAL ON THE DISCHARGE AXIS WITH ELECTRON OSCILLATION IN MAGNETIC FIELD. M. D. Gabovich, O. A. Bartnovskii, and Z. P. Fedorus. *Zhur. Tekh. Fiz.* **30**, 345-53(1960) Mar. (In Russian)

The potential "channel" formed in a magnetic ion source

is studied, and the causes of potential sag and conditions favorable to its increase are investigated. The method for determining the space potential is presented. (R.V.J.)

19649

THE ROLE OF REPEATED PROCESSES IN FORMATION OF PROTONS IN ION SOURCES. M. D. Gabovich (Kiev Inst. of Physics, Academy of Sciences, Ukrainian, SSR). *Zhur. Tekh. Fiz.* **30**, 354-8(1960) Mar. (In Russian)

Proton production in multiple processes related to electron collisions with heavy particles is analyzed, and it is shown that in a low-pressure plasma discharge with a relatively small degree of ionization (high-frequency plasma source) the production of protons takes place mainly by molecular dissociation followed by atomic ionization. It is also shown that in the case of hydrogen atom recombination on a metallic surface the corresponding coefficient can be smaller than unity and this factor should be considered in proton production analysis. (tr-auth)

19650

TIME OF APPEARANCE OF DISCHARGE IN GAS DISCHARGE MANOMETER. A. S. Borodkin. *Zhur. Tekh. Fiz.* **30**, 359-64(1960) Mar. (In Russian)

It is shown that the ignition time function in gas discharge magnetic manometers has a maximum. Relations are derived for the maximum as a function of intensity along the discharge and of gas pressure. The mean time of discharge ignition at pressures of 7×10^{-8} to 3×10^{-8} mm of mercury is approximately inversely proportional to pressure. (tr-auth)

19651

THERMOELECTRIC CONVERTERS OF HEAT AND ENERGY. L. N. Dobretsov (Inst. of Physics and Tech., Academy of Sciences, Leningrad). *Zhur. Tekh. Fiz.* **30**, 365-94(1960) Apr. (In Russian)

An analysis is made of three types of thermoelectric converters: the vacuum type of thermoelectric converter without electron volume charge compensation; the thermionic converter with electron volume charge compensation by positive Cs^+ ions produced in surface ionization on the cathode; and the plasmic converter with electron volume charge compensation by positive ions. 23 references. (R.V.J.)

19652

MAGNETIC CYLINDRICAL LENSES WITH THE ANTI-SYMMETRY PLANE. S. Ya. Yavor, E. V. Shpak, and R. M. Minina (Inst. of Physics and Tech., Academy of Sciences, Leningrad). *Zhur. Tekh. Fiz.* **30**, 395-404(1960) Apr. (In Russian)

Cylindrical magnetic lenses with plane anti-symmetry composed of infinite rectilinear, parallel conductors are studied. The field distribution in the mean plane and the linear image positions are measured and calculated as functions of lens current. (tr-auth)

19653

ON THE AMPLITUDE CHANGE OF THE VERTICAL BETATRON OSCILLATIONS IN EXTRACTION ACCELERATOR BEAM WITH THE REGENERATIVE DEFLECTOR. Yu. Ya. Lembra (Inst. of Physics and Tech., Academy of Sciences, Leningrad). *Zhur. Tekh. Fiz.* **30**, 405-12(1960) Apr. (In Russian)

The method of curvatures is applied in the investigation of amplitude variations in vertical betatron oscillations during beam extraction by regenerative deflectors. Accelerators with particles moving in periodic magnetic systems are studied. The ratio of perturbed and unperturbed motions was found by measuring the vertical betatron oscillations.

tion amplitude variations. A simplified evaluation of amplitude variations in oscillations was made by averaging the maximum squares of the ratio and relating this to the initial phase of betatron oscillations for the case of narrow regenerator. (tr-auth)

19654

ELECTRON BEAM OPTIMAL FOCUSING IN DRIVING THROUGH THE ENTRANCE WAVEGUIDE OF THE MOVING WAVE TUBE WITH PERIODIC MAGNETIC FIELD. A. L. Igritskii (Ul'yanov (Lenin) Leningrad Electrotechnical Inst.). Zhur. Tekh. Fiz. **30**, 413-23(1960) Apr. (In Russian)

A method is suggested for calculating electron trajectories. New methods are also offered for reducing electron beam undulation and for determining the magnetic field configuration at the transition point. It is shown that at the transition point the magnetic field becomes the "transformer" of the electron beam. Calculations are made for an electromagnet for securing the desired magnetic field at the transition point. (tr-auth)

19655

ABOUT SOME PROCESSES IN THE AIR AFTER DISCHARGE. I. E. Balygin. Zhur. Tekh. Fiz. **30**, 433-41(1960) Apr. (In Russian)

Post-probe discharge fluctuations are analyzed. With certain discharge current restrictions, an intense deionization takes place in a spark channel following air probes of 2 to 6 mm. Subsequently the intensity is reduced until a new resurgence of intensity appears with the cessation of discharge. During the period of reduced intensity some intrinsic discharge may appear in the spark channel plasma, during which the electrode intensity does not fluctuate in spite of the large drop in applied pulse amplitude. High-frequency sinusoidal oscillations appear following air probes in spark channels at certain discharge current confinement. The probe intensity of ionized air is smaller than non-ionized air in uniform fields. (R.V.J.)

19656

ABOUT PROBE MEASURING AT MEDIUM PRESSURES. V. M. Zakharova, Yu. M. Kagan, K. S. Mustafin, and V. I. Perel (Zhdanov Leningrad State Univ.). Zhur. Tekh. Fiz. **30**, 442-9(1960) Apr. (In Russian)

A probe method for measuring plasma parameters is suggested for the case in which the free particle range is smaller than the probe. The theory was verified in mercury vapor discharge. Plasma parameters for mercury, neon, and argon were measured at pressures of 1 to 20 mm mercury. (R.V.J.)

19657

THE NON-STATIONARY STREAM OF CONDUCTING LIQUID IN A PLANE CHANNEL WITH MOVING BORDERS. Ya. S. Ufland and I. B. Chekmarev (Inst. of Physics and Tech., Academy of Sciences, Leningrad). Zhur. Tekh. Fiz. **30**, 465-71(1960) May. (In Russian)

A mathematical solution is presented for a one-dimensional non-stationary problem in magnetohydrodynamics for a plane-parallel layer in a transverse magnetic field with the interface lamina moving at an assigned velocity. The solution considers the induction currents traveling in the surrounding medium (channel walls). It is shown that the problem is related to the periphery problems in mathematical physics with mixed spectra. (R.V.J.)

19658

ELECTROSTATIC FIELD OF TWO COAXIAL CYLINDERS AS AN ELECTRON LENS. N. N. Lebedev and I. P. Skalskaya (Inst. of Physics and Tech., Academy of Sci-

ences, Leningrad). Zhur. Tekh. Fiz. **30**, 472-9(1960) May. (In Russian)

The problem of field distribution in a lens formed by two coaxial cylinders is resolved. The analysis utilized the resolution of a pair of integral equations derived by the theory of functions of complex variables. The derived formulas were used in calculating the potential distribution along the lens axis for various ratios of internal and external cylinder radii. (tr-auth)

19659

THE POSSIBILITY OF APPLICATION OF A NON-HOMOGENEOUS MAGNETIC FIELD FOR HIGH INTENSITY ELECTRON BEAM FORMATION. Yu. V. Troitskii (Inst. of Radiophysics and Electronics, Siberian Section of the Academy of Sciences, USSR, Novosibirsk). Zhur. Tekh. Fiz. **30**, 512-21(1960) May. (In Russian)

Experimental data are presented on the influence of a magnetic field on the characteristics of an axially-symmetric Pierce-type electron gun with a converging beam. The gun is confined by a magnetic screen of configuration which aligns the magnetic lines along the calculated trajectories. The system forms high-compression electron beams with well defined boundaries. The results are compared with the previously postulated theory. (tr-auth)

19660

IONIZATION OF FAST ATOMS OF Na, K, Rb, AND Cs IN COLLISIONS WITH MOLECULES OF H₂, D₂, N₂, AND O₂. Yu. F. Bydin and A. M. Bukhteev (Inst. of Physics and Tech., Academy of Sciences, Leningrad). Zhur. Tekh. Fiz. **30**, 546-54(1960) May. (In Russian)

The effective ionization cross sections for interactions of fast atoms of Na, K, Rb, and Cs with H₂, D₂, and O₂ were measured at energies of 150 to 1200 ev. The energy thresholds for Cs-H₂ (740 ev), Cs-D₂ (60 ev), Rb-H₂ (490 ev), and Rb-D₂ (280 ev) were observed. The obtained data are analyzed from the point of view of Mecc's quasi-adiabatic hypothesis and the concept of potential curves corresponding to initial and finite energy states of two slowly approaching particles. (tr-auth)

19661

STATIONARY FLOW OF CONDUCTING FLUID IN INFINITELY LONG ANNULAR TUBE WITH RADIAL MAGNETIC FIELD. I. B. Chekmarev (Kalinin Leningrad Polytechnical Inst.). Zhur. Tekh. Fiz. **30**, 601-5(1960) June. (In Russian)

Three particular cases of incompressible viscous conducting flow in an infinitely long annular tube with a radial magnetic field were analyzed, and precise solutions of magnetohydrodynamic equations for these cases are derived. Cases of flow between infinitely long, coaxial, penetrable cylinders with constant pressure drop and constant injection or removal of fluid and of a stationary twisted flow in an infinitely long non-conducting non-penetrable annular tube are examined. Some suggestions are offered on flow control by magnetic and electric fields. (R.V.J.)

19662

GAS PARAMETER VARIATIONS OF NON-HOMOGENEOUS DISSOCIATION BEHIND THE SHOCK-WAVE. Yu. P. Lunkin (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz. **30**, 622-6(1960) June. (In Russian)

An approximate solution is derived for equations describing non-equilibrium gas dissociation behind shock waves. (tr-auth)

19663

ELECTROMAGNETIC WAVES IN A SPIRAL WAVEGUIDE WITH ANISOTROPIC DIELECTRIC. V. P. Shestopalov, V. A. Slusarevskii, S. D. Andrenko, and E. I. Chernyakov (Gor'kiĭ Khar'kov State Univ., USSR). *Zhur. Tekh. Fiz.* **30**, 644-62(1960) June. (In Russian)

Dispersion equations are derived, and the propagation of symmetric and asymmetric waves in spiral waveguides with an isotropic dielectric tube, inside which is an anisotropic dielectric, was analyzed. (R.V.J.)

19664

ABOUT A CLASS OF PLANE MAGNETO-HYDRODYNAMIC PROBLEMS. K. A. Lur'e (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* **30**, 736-8(1960) June. (In Russian)

A mathematical analysis is made of the plane Oxy in a stationary flow of non-viscous incompressible liquid with conductivity σ . The magnetic field is considered perpendicular to the flux ($H = H_z$). (R.V.J.)

19665

MAGNETOHYDRODYNAMICALLY DRIVEN VORTICES. W. S. Lewellen (Space Technology Labs., Inc., Los Angeles). p.1-15 of "Proceedings of the 1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, California, June 15, 16, 17, 1960." David M. Mason, William C. Reynolds, and Walter G. Vincenti, eds. Stanford, California, Stanford University Press, 1960.

A magnetohydrodynamic body force is considered as a means of driving a two-dimensional, axisymmetric, steady vortex in a viscous, conducting fluid. The equations governing the motion are presented and briefly discussed. Applied magnetic and electric fields are chosen in accordance with Maxwell's equations, and in such a way as to yield a tangential body force. It is shown that whenever the magnetic Reynolds number based on the radial velocity component is much less than one, the tangential body force due to the induced magnetic field can be neglected in comparison with that due to the applied. For these conditions the problem reduces to that of solving a second-order, linear differential equation for the tangential velocity. Analytic solutions are found for two cases: one involving radial currents and the other, axial currents. The fundamental dimensionless parameters in each case are the Hartmann number, the Reynolds number based on the radial mass flow, and the ratio of the applied to the induced electric field. The results are plotted for reasonable values of these parameters. The effect of the applied magnetic and electric fields on the temperature and pressure distributions in an adiabatic, compressible vortex is presented. (auth)

19666

MATERIALYA V SOVESHCANIYA PO LUMINESTSENTSII TARTU 25-30 IYUNYA 1956 G. (Reports of the Fifth Conference on Luminescence (Phosphor Crystals) Tartu, June, 1956). Ch. B. Lushchik, ed. Tartu, Akademiya Nauk Estonskoi SSR, 1957. 391p.

Papers are included on investigations of the luminescence of fluorine sulfide and other crystal phosphors; mechanisms of center capture, radiation effects, preparations of lumino-phors, and chemical methods of determining small quantities of admixtures. (R.V.J.)

19667

MATERIALYA VII SOVESTANIYA PO LYUMINESTSETSII (KRISTALLOFOSFORY) MOSKVA, 26 IYUNYA-3 IYULYA 1958 G. (Reports of the VII Conference on Luminescence (Crystalphosphors), Moscow, June 26 to July 3, 1958).

N. E. Lushchik, ed. Tartu, Akademiya Nauk Estonskoi SSR, 1959. 390p.

Fifty one papers are included on the physics of alkali-halide crystal luminescence. (R.V.J.)

19668

Leeds and Northrup Co., Philadelphia.

THERMOELECTRIC THERMOMETRY. A Monograph on the Materials and Methods Involved in the Measurement of Temperature with the Aid of Thermocouples in Accordance with the Practice of the Leeds & Northrup Company. Paul H. Dike. 1958. 100p. \$1.00.

The materials and methods involved in the measurement of temperature with the aid of thermocouples are discussed. The discussion includes elementary principles of temperature measurement by thermoelectric methods, thermocouple materials, fabrication of thermocouples, installation of thermocouples, extension wires for thermocouples, measurement of thermocouple EMFS, standardization and calibration of thermocouples, applications of thermocouples, conditions which limit the use of thermocouples, trouble shooting, and relationships of EMF and temperature. (W.L.H.)

Astrophysics and Cosmology

19669

ABUNDANCE DISTRIBUTION OF RARE GAS ISOTOPES IN IRON METEORITE TREYSA. H. Fechtig, W. Gentner, and G. Kistner. *Geochim. et Cosmochim. Acta* **18**, 72-80 (1960) Jan. (In German)

The rare gases He, Ne, and Ar and their isotopic composition were investigated in the Fe meteorite Treysa. The meteorite showed a He^4 -content of $\sim 21 \times 10^{-6} \text{ cm}^3/\text{g}$, an Ar^{36} -content of $\sim 15 \times 10^{-6} \text{ cm}^3/\text{g}$ and a Ne-content of $\sim 6 \times 10^{-6} \text{ cm}^3/\text{g}$. In dependence of depth the isotopic ratio of Ar^{38}/Ar^{36} and He^4/He^3 varied about 20% in the investigated disk. This variation of the isotopic ratio may be qualitatively explained by the results of spallation investigations on Cu with 0.34 and 2.2 Gev protons and on steel with 0.16, 0.43, and 3.0 Gev protons. Assuming the ratio of the average postatmospheric radius to the average pre-atmospheric radius of Treysa is 0.44 and the spectrum of the cosmic radiation extends down to 500 Mev, it was found by calculation that the variation of the Ar^{38}/Ar^{36} -ratio will be caused only by the primary component. The variation of the He^4/He^3 -ratio is presumably a consequence of a secondary radiation. The amount of Ar^{38} found in the disk gave a radiation age of $\sim 10^9$ years. (*GeoScience Abstr.* **2**, No. 5, 1960)

19670

ARGON-39 AND TRITIUM IN METEORITES. E. L. Fireman and J. DeFelice. *Geochim. et Cosmochim. Acta* **18**, 183-92(1960) Feb.

The radioactive isotopes Ar^{39} and tritium are measured in a number of Fe and stone meteorites. The stable isotope He^3 is also measured and the Ar^{38} content is estimated from the He^3 content. The cosmic ray exposure ages obtained from the Ar^{39} and Ar^{38} are: 4.2×10^8 years for the Sikhote-Alin Fe meteorite, 4.5×10^8 years for the Treysa Fe meteorite, 0.3×10^8 years for the Pitts Fe meteorite, 5×10^8 years for the Norton County achondrite, and 0.8×10^8 years for the St. Michel chondrite. The ratio of tritium to Ar^{39} radioactivities at the time of fall is 140 ± 20 for the Norton County meteorite, 56 ± 15 for the St. Michel meteorite, 6 ± 1 for the Treysa meteorite, and less than $1/2$ for the Sikhote-Alin meteorites. For the stone meteorites this ratio is consistent with the production

probabilities and the hypothesis of the constancy of cosmic rays. For the Fe meteorites this is lower than expected from the production probabilities. Either the cosmic-ray bombardment is not constant or tritium loss from diffusion occurs for the Fe meteorites. Also reported is the lack of Ar^{39} and tritium in a number of undated Fe meteorite falls, which indicates that they fell more than 1,500 years ago. Only 1 undated Fe meteorite fall, Washington County, gave a small trace of Ar^{39} , indicating that it fell about 1,000 years ago. Possible interpretations of the cosmic ray exposure ages are discussed. (*GeoScience Abstr.* **2**, No. 5, 1960)

19671

ORIGIN OF TERRESTRIAL TRITIUM. A. T. Wilson and G. J. Fergusson. *Geochim. et Cosmochim. Acta* **18**, 273-7 (1960) Feb.

The possibility of tritium being accreted by the earth from some extraterrestrial source is considered and shown to be highly improbable. The production rate of tritium in the earth's atmosphere by cosmic rays was calculated from data on the experimentally observed tritium content of meteorites ($0.63^{+0.4}_{-0.4}$ H^3 atom/ cm^2 per sec), and also from cosmic ray flux data and nuclear evaporation theory (1.3 ± 0.5 H^3 atom/ cm^2 per sec). These results are in reasonable agreement with the experimentally determined terrestrial accumulation rate of tritium of 1.0 ± 0.3 H^3 atom/ cm^2 per sec. It thus appears that cosmic-ray spallation reactions in the earth's atmosphere are the prime, if not the sole, source of terrestrial tritium. (*GeoScience Abstr.* **2**, No. 5, 1960)

19672

STUDIES ON THE EXCITATION OF AURORA BOREALIS. I. THE HYDROGEN LINES. A. Omholt. *Geofys. Publikasjoner, Norske Videnskaps-Akad., Oslo* **20**, No. 11, 1-40 (1959). (In English)

Intensity measurements on the $\text{H}\beta$ line and the N_2^+ band $\lambda 4709$ were made in Tromsø with a new photoelectric filter photometer, which is described in some detail. It is found that the intensity ratio $\text{H}\beta/\lambda 4709$ is always very low, usually less than 0.1. $\text{H}\beta$ is virtually absent from homogeneous as well as rayed arcs and bands, and from pulsating aurorae, whereas $\text{H}\beta$ is usually associated with rays and diffuse aurorae. The results of some earlier observations at Yerkes Observatory are described. At this low latitude $\text{H}\beta$ is always present in homogeneous arcs, but less intense in rayed aurorae. One observation of the break-up period of an arc is described. An attempt is made to relate the various observations available and to form a consistent picture of the behavior of the hydrogen lines. The total energy carried into the atmosphere by the primary particles producing the aurora is computed, and it is concluded that the influx of energy required to maintain an aurora of international brightness III in the zenith is about 6×10^{31} ev/ cm^2sec . Some new computations on the emission of $\text{H}\alpha$ and $\text{H}\beta$ quanta from H^+ / H beam in air, versus the velocity of the particles, are presented. The total emission of $\text{H}\alpha$ and $\text{H}\beta$ quanta per incident proton with initial energy above 200 kev is found to be about 60 and 15, respectively. The possibility of collisional deactivation of the excited H-atoms is discussed. During the period when the particles are neutralized (H-atoms) they are not bound to a magnetic field line, and this may be of importance for the diffusion of a narrow beam of primary particles. The angular distribution of protons which move from near the equatorial plane to the auroral zone is discussed, an electric field being taken into account. One may expect that the angle which the paths of the fastest

protons make with the magnetic lines of force is rather small, but that this angle increases with decreasing energy. The role of the protons in the auroral displays is discussed on the basis of the observations and the theoretical results. It is shown that protons cannot regularly be responsible for the main excitation of any of the discussed types of aurora. It is not possible from the intensity of $\text{H}\alpha$ and $\text{H}\beta$ to derive the absolute flux of protons. From the Doppler profiles it is at present not possible to derive the dispersion in initial velocity of the particles, but it is evident that a rather large fraction of these have quite low velocities. If all emitting atoms whose directions have an azimuth within an infinitesimal small interval $d\phi$ are considered then, the average velocity vector for these atoms makes an angle of about 24° with the magnetic lines of force. There is evidence that the angular distribution of the incident protons varies with the energy as theoretically predicted. (auth)

19673

OSCILLATIONS OF ROTATING COSMICAL BODIES IN THE PRESENCE OF MAGNETIC FIELD. J. N. Tandon (Indian National Committee for the IGY, National Physical Lab., Delhi). *Indian J. Phys.* **34**, 107-17 (1960) Mar.

The effect of rotation on the radial pulsations of cosmical fluid masses with special reference to spherical mass (magnetic variables) and cylindrical mass (spiral arm, solar-ion stream) was investigated for fluids having volume electric currents. Two models of current systems considered for cylindrical mass were circular currents and line currents. It was found that for radial pulsations, rotation helped in the dynamical stability of the cosmical bodies. (auth)

Cosmic Radiation

19674 NP-8824

General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.

MINIMUM ARGOTRON MIRROR HEIGHTS AS DETERMINED BY THE GEOMAGNETIC FIELD. Roy W. Hendrick, Jr. Nov. 9, 1959. 10p. (RM-59TMP-48)

For an electron trapped in the geomagnetic field, the altitude of its mirror point was found to vary as it drifted around the earth due to the eccentricity of the geomagnetic dipole and local magnetic anomalies. The variation in altitude of the mirror points of those electrons which would just graze the earth at their lowest point was computed for the area of the northern magnetic hemisphere south of the auroral zone. The ground trace of a particular shell was located, the minimum magnetic field strength for that shell determined, and the minimum height above the earth's surface necessary to obtain a magnetic field decrease to this minimum was computed. A ridge running over the United States, Europe, and southern Russia in which argotrons had to have a minimum altitude of some 1200 km higher than their lowest point was found. Minimum heights in the northern hemisphere declined both to the north and south of this ridge. (M.C.G.)

19675 NP-8829

Michigan. Univ., Ann Arbor.

COSMIC RAY INVESTIGATIONS. ANNUAL PROGRESS REPORT. May 31, 1960. 7p. Contract Nonr-1224(07).

The arrangement of the ionization chamber array is discussed in connection with accommodations for a 30-in. cloud chamber. The chambers are thin walled, in order to reduce local nuclear interactions. A pulse rate of ~ 4 per hr provides events of a minimum size observable in the ion

chambers, i.e., a density of 3 or 4 particles in 0.1 m^2 . The location and operation of the 30-in. cloud chamber are discussed. A MIT 60-in. cloud chamber is being installed in the array to aid in the identification and energy estimation of the nuclear components. Electromagnetic interactions leading to direct pair production by muons underground were investigated. (B.O.G.)

19676

ENERGY SPECTRUM OF ELECTRON PAIRS IN A HIGH ENERGY PHOTON-ELECTRON CASCADE. J. Pernegr, V. Petržilka, J. Sedlák, and J. Vrána (Inst. of Physics, Czechoslovak Academy of Sciences, Prague and Charles Univ., Prague). Czechoslov. J. Phys. **10**, 342-8 (1960). (In English)

The energy spectrum of electron pairs generated in a high energy photon-electron cascade up to a depth of 1.5 cascade units was measured. The possible influence of the medium on the shape of the spectrum according to Landau-Pomeranchuk-Ter Mikaelian and Migdal was investigated. Two procedures were used for the analysis. No significant deviation from the Bethe-Heitler spectrum could be observed. Different ways of estimating the primary energy were applied and the resulting value, 2×10^{12} ev, was accepted as the primary energy. (auth)

19677

THREE "VELOCITIES" OF CORPUSCULAR FLOW FROM CHROMOSPHERIC FLARES. O. M. Barsukov (Inst. of Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 5, 743-5 (1960) May. (In Russian)

A definite bond between geoelectromagnetic activity and chromospheric flares was confirmed by new indices of field perturbation in telluric currents. Daily magnitudes of telluric current perturbations were recorded during July 1957 to July 1958 in order to determine the time dependence of electromagnetic storms on solar activity. Correlations with data obtained during 1946 to 1948 showed three retarding times in geoelectromagnetic storms in relation to F region passage through the central meridian, corresponding to three corpuscular flow "velocities." (R.V.J.)

19678

MEASUREMENTS OF CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE. L. A. Antonova and G. S. Ivanov-Kholodnyi (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 5, 756-7 (1960) May. (In Russian)

Corpuscular radiation was measured at $\sim 100 \text{ km}$ at mean latitudes and in polar regions. The data at mean latitudes were less accurate due to the effects of light scattering. Signals recorded at 70 and 100 km, determined by correlations of upper trajectories in front of a photomultiplier with absorbers of 1.8 and 2.0 mg/cm^2 , indicate an electron flux with $\sim 40 \text{ kev}$ energy. It is shown that the corpuscular flux is reduced above $\sim 100 \text{ km}$. Data taken in polar regions, when the intensity of corpuscular radiation is more intense, are tabulated. (R.V.J.)

19679

AN ATTEMPT TO DETECT ENERGETIC GAMMA RADIATION FROM THE SUN. Robert E. Danielson (Univ. of Minnesota, Minneapolis). J. Geophys. Research **65**, 2055-9 (1960) July.

A γ -ray telescope was constructed to detect solar γ rays with energies greater than about 200 Mev. This telescope was manually operated during a Stratolab flight for about 40 minutes. An upper limit to the flux of γ radiation from the sun during this time was found to be $0.008 \text{ photon/cm}^2$

sec. This is roughly 1 per cent of the cosmic-ray flux. (auth)

19680

INTENSITY MINIMUM IN COSMIC-RAY NEUTRONS DURING THE INTERNATIONAL GEOPHYSICAL YEAR. Masahiro Kodama and Masami Wada (Inst. of Physical and Chemical Research, Tokyo). J. Geophys. Research **65**, 2203-5 (1960) July.

Long-term variation in cosmic neutrons during the International Geophysical year from July 1957 to December 1958 was investigated. Data from stations at Thule, Sulphur Mt., Climax, Zugspitze, Berkeley, Rome, Buenos Aires, Mt. Norikura, and Huancayo were adapted for analysis. The month of minimum intensity during IGY was determined for each station. The rate of variation showed definite indications of latitude dependence during the period of intensity decrease, but was nearly independent of latitude after the minimum. (M.C.G.)

19681

CLOUD CHAMBER EVIDENCE FOR THE PRESENCE OF SIMULTANEOUS HIGH ENERGY NUCLEAR-ACTIVE PARTICLES AT MOUNTAIN ALTITUDES. S. Naranan, R. Raghavan, P. V. Ramanamurthy, B. V. Sreekantan, and A. Subramanian (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) **16**, 401-11 (1960) May 1. (In English)

In an examination of 22,000 pictures of penetrating showers recorded with a multiplate cloud chamber, in a time of operation of 5,310 hours at an altitude of 2.2 km, 32 cases were obtained in each of which two or more simultaneous parallel high energy nuclear-electromagnetic cascades, ($\sim 100 \text{ Bev}$), are seen developing in the plates of the chamber. The visible energy of the individual cores was determined by the track length method. It is found that in most of the cases the visible energies of the parallel cascades in a picture are of comparable magnitude. The separation between the cores ranges from 5 to 40 cm, and the corrected distribution looks flat. There is clear indication that about half of the events are associated with dense air showers. The unassociated events are interpreted in terms of local nuclear interactions of particles of energy $\geq 450 \text{ Bev}$ in air up to a height of 140 meters above the apparatus. The associated events are explained as being parts of air showers containing about 100 nuclear-active particles of energy $\geq 100 \text{ Bev}$ near the core. (auth)

19682

CLOUD CHAMBER STUDY OF EXTENSIVE AIR SHOWERS. T. Gémesy, T. Sándor, and A. Somogyi (Central Research Inst. of Physics, Hungarian Academy of Sciences, Budapest). Nuovo cimento (10) **16**, 412-15 (1960) May 1. (In English)

Measurements were carried out by means of a multiplate cloud chamber controlled by an extensive air shower arrangement in order to check the earlier results concerning the transition effect of the extensive air showers as well as to determine a more precise value of the photon/electron ratio. The latter quantity was found to be 1.13 or 1.44, according to whether single tracks emerging from a lead plate were considered photons. A discrepancy was found in the transition effect which may be due to differences in experimental conditions for the cloud chamber and GM-counters. (D.L.C.)

19683

COSMIC RAY INVESTIGATIONS WITH AN AIRBORNE NEUTRON MONITOR. M. A. Pomerantz, V. R. Potnis, and S. P. Agarwal (Franklin Inst., Swarthmore, Penna.). Nuovo cimento (10) **16**, 469-75 (1960) May 1. (In English)

A neutron monitor was in operation aboard a magnetic survey aircraft. During a cruise in November 1958, the latitude effect of the nucleonic component was measured over the same route between Tokyo and the Aleutian Islands as that covered by Sandström in February 1957. Although the two sets of data normalized at Tokyo are in agreement up to approximately 43° N (modified geomagnetic latitude), a change in the shape of the curve occurred at higher latitudes. The intensity at 55° N decreased by 13%, and the knee shifted from 47° N to 43° N. The latitude variation of the absorption mean free path was determined from intensity vs. altitude curves at geomagnetic latitudes 50, 37, 25, and 13° N. A change of roughly 10% over a range of primary cut-off rigidity from 2 to 15 Bev was indicated. Comparison with earlier results of others revealed no appreciable variation of the mean free path during the solar cycle. (auth)

19684

OBSERVATION OF A SHORT-LIVED COSMIC-RAY SOLAR FLARE INCREASE WITH A HIGH-COUNTING-RATE MESON DETECTOR. R. A. R. Palmeira and K. G. McCracken (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev. Letters* 5, 15-16(1960) July 1.

Observations are reported of a very abrupt and short-lived cosmic-ray increase which occurred on May 4, 1960. These data were obtained by meson telescopes, of total sensitive area 10 m² and total counting rate ≈900 cps. The minimum μ -meson momentum accepted by the telescope was ~202 Mev/c. The most outstanding feature of the cosmic-ray effect was the very short time scale, the rising and decaying intensity being much shorter than those observed during any previous case of this type event. (B.O.G.)

19685

ENERGY SPECTRA OF THE ELECTRON-PHOTON COMPONENT IN BROAD ATMOSPHERIC SHOWERS NEAR THE SHOWER AXIS. O. I. Dovzhenko, S. I. Nikol'skiĭ, and I. V. Rakobol'skaya (Lebedev Inst. of Physics, Moscow). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1361-9(1960) May. (In Russian)

A cloud chamber with lead plates was employed to investigate the electron-photon component of broad atmospheric showers at sea level. Showers containing on the average $8 \cdot 10^3$, $1.2 \cdot 10^4$, and $3 \cdot 10^4$ particles and passing at distances of 0 to 3 m from the chamber were selected. Energy spectra of the electron-photon component were derived and the fraction of high energy electrons and photons in ranges of 0 to 3 m and 0 to 0.3 m from the shower axis were determined. The spatial distributions of high energy electrons and photons for distances of 0 to 0.3 m from the axis were also obtained. (auth)

19686

FLUCTUATIONS IN THE ANGULAR DISTRIBUTION OF SECONDARY PARTICLES OF EXPLOSIVE SHOWERS. B. A. Nikol'skiĭ and A. P. Mishakova. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1507-11(1960) May. (In Russian)

Calculations are carried out on the fluctuations in the angular distribution of shower particles which imitate the (double center) shower production mechanism. It is concluded that most experimentally observed showers possessing a (double center) angular distribution can be explained by natural statistical fluctuations in the angular distribution. The calculations are performed by the Monte Carlo method. (auth)

MENTS USING PULSED NEUTRON METHODS. E. G. Silver. May 16, 1960. 8p. Contract [W-7405-eng-26]. OTS.

Consideration is given to the possibility that in certain types of processing or storage facilities handling enriched fissionable isotopes the pulsed neutron method can give a useful measure of the subcriticality of the system. The proposed method describes how the concentration and multiplication constant are determined for an assembly of unknown concentrations. Such measurements might be undertaken if high γ levels indicate the possibility of excessive concentrations of fissionable materials. Experiments were performed at the BSF in which progressively more subcritical configurations of BSR-I fuel elements were assembled. The multiplication constants were measured by the source-and-detector and pulsed-neutron methods. (B.O.G.)

19688 CRRP-914

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

AN ESTIMATE OF THE REACTIVITY OF ASSEMBLIES OF NRX FUEL ELEMENTS IN LIGHT WATER. R. G. Jarvis. Mar. 1960. 62p. (AECL-1010). AECL.

Calculations on the criticality of assemblies of NRX fuel elements in light water are presented. The elements are dealt with in three sections, "X rods" of natural uranium, enriched elements of U²³⁵-Al alloy and enriched elements of Pu-Al alloy. Values of k_{∞} and B^2 are provided for two fuel concentrations for each of the two enriched types and for a range of irradiations of the X rods. The calculations for the X rods provided maximum and minimum values of k_{∞} . The maximum values for some lattices are a few per cent above unity. Unfortunately, the present experimental evidence does not prove that it is impossible to achieve values of k_{∞} greater than unity in lattices of natural uranium in light water. Hence for safety predictions maximum values were used. The resulting restrictions are not very severe. It is possible to make critical assemblies of the enriched elements. A set of recommended minimum spacings such that elements of all kinds may safely be mixed in a stack together is given. There are also predictions of the minimum critical numbers of complete elements or elements cut into slugs. (auth)

19689 HW-65328

General Electric Co. Hanford Atomic Products Operation, Richland Wash.

NUCLEARLY SAFE MASS LIMITS, VOLUME LIMITS, INFINITE CYLINDER DIAMETERS AND SLAB THICKNESSES FOR SLIGHTLY ENRICHED URANIUM RODS IN LIGHT WATER. E. D. Clayton. May 24, 1960. 15p. Contract AT(45-1)-1350. OTS.

A series of investigations involving critical approach and exponential measurements made with 3.06% enriched U is reported. Data from these experiments were used to calculate critical parameters and safe values which are shown graphically. The data pertain to U rods of diameters which in one case result in the minimum critical mass, and in the second case give the maximum buckling. An illustrative problem in nuclear safety is included in which mass and volume are discussed for a hypothetical dissolver used to process U fuel elements of 3.1% enrichment. (J.R.D.)

19690

FEW GROUP ANALYSIS OF D₂O-U²³⁵ ASSEMBLIES. Charles N. Kelber and Philip Kier (Argonne National Lab., Ill.). *Nuclear Sci. and Eng.* 8, 1-11(1960) July.

Few-group analysis is applied to a variety of D₂O-U²³⁵ critical assemblies. Use of relatively simple prescriptions for obtaining group constants is sufficient to give good values of the reactivity over a wide range of concen-

Criticality Studies

19687 CF-60-5-130

Oak Ridge National Lab., Tenn.

A PROPOSAL FOR CRITICALITY CONTROL MEASURE-

trations of U^{235} in D_2O . Among these simple prescriptions is one which attempts to take into account the spatial variation in the neutron spectrum in reflected systems. This prescription improves the calculated reactivity by about 5% over that obtained with only a single thermal neutron spectrum characteristic of the core. (auth)

19691

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

DISPOSITIVO PARA ENSAYOS CRITICOS (RA-1.5). Informe No. 11. (Critical Assembly (RA-1.5). Report No. 11). Carlos Domingo, Miguel Geiger, Velia Hoffmann de Geiger, and Jorge Sare. 1959. 19p.

The RA-1.5 critical assembly is briefly described. The procedures used in the testing of the safety apparatus and in the determination of the critical mass are given. The results of five critical tests are presented. (J.S.R.)

19692

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

MEDICIÓN DEL LAPLACIANO DE UN RETICULADO DE $U-H_2O$ CON TUBOS CONTENIENDO POLVO DE U_3O_8 ENRIQUECIDO AL 20%. Informe No. 18. (Measurement of the Laplacian of a $U-H_2O$ Lattice with Tubes Containing 20% Enriched U_3O_8 Powder. Report No. 18). D. Bovisio de Ricabarra, R. Faradjie de Turjanski, and J. U. Koppel. 1959. 18p.

The laplacian was measured for a $U-H_2O$ lattice with a hexagonal cell of 16 mm, exterior tube diameter of 9.5 mm, aluminum thickness of 0.9 mm, and apparent density of U_3O_8 of 2.25 g/cm^3 . The values obtained were: the radial laplacian $\alpha^2 = 99.2 \pm 4.0 \text{ m}^{-2}$, axial laplacian $\gamma^2 = 32.6 \pm 0.6 \text{ m}^{-2}$, and total corrected laplacian $B^2 = 132.2 \pm 4.6 \text{ m}^{-2}$. The theory and method of measurement are discussed. The techniques used are described and the errors in measurements are considered. (J.S.R.)

Elementary Particles and Radiations

19693 AERE-NP/GEN/13

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

TABLES OF MOMENTUM AND ENERGY TRANSFERS IN THE SCATTERING OF THERMAL NEUTRONS. P. A. Egelstaff and C. R. T. Heard. Jan. 1960. 109p.

In designing experiments, it is useful to be able to compare the ranges of momentum and energy transfer which can be observed in various cases and to see what limitations are set by the conservation laws on the information obtained from the experiment. A collection of tables and graphs is presented which should fill this need. (W.D.M.)

19694 AERE-R-3306

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DEUTERON TRIPLE-SCATTERING EXPERIMENTS. R. J. N. Phillips. Mar. 1960. 12p. BIS.

It is concluded that triple scattering or equivalent measurements are needed in general to determine the deuteron scattering matrix for a spin-0 target. The unfamiliar features introduced by the unit spin of the deuteron are discussed. It was determined that seven of the eight components of deuteron polarization may be analyzed with a calibrated spin-0 third scatterer. The eighth component can be found when the longitudinal spin axis is rotated out of the direction of motion by a magnetic field. (C.J.G.)

19695 AFOSR-TN-60-462

Goucher Coll., Towson, Md. and Johns Hopkins Univ., Baltimore.

THE MASS OF THE Λ^0 HYPERON. J. Lodge, F. Anderson, E. B. Brucker, A. Pevsner, and R. Strand. May 1960. 9p. Contract AF18(603)-143.

The mass of the Λ^0 hyperon was measured using nuclear emulsion techniques. A value of $1115.55 \pm 0.15 \text{ Mev}$ was determined from twenty-five closely grouped events. (C.J.G.)

19696 AFOSR-TN-60-745

Miami. Univ., Coral Gables, Fla.

INTERACTIONS AND DECAYS OF HYPERONS PRODUCED IN K^- CAPTURE STARS AT REST. M. Blau, C. F. Carter, and A. Perlmutter. May 31, 1960. 46p. Contract AF49(638)-97.

The results of an investigation of hyperon interactions and decays are presented. Several inelastic interactions are described. The mean free path for nuclear interactions of charged Σ hyperons in emulsion was found to be $11 \pm 4 \text{ cm}$ in the energy range 10 to 200 Mev. Possible examples of a hyperon and pion produced in the interaction of a K^- at rest with two or more nucleons are presented, suggesting that this mode of interaction is not as rare as was previously supposed. A table of positively identified Λ^0 hyperfragments is given. The decay of a Σ^+ via the proton mode and a Dalitz pair is described. Possible evidence is given for the decay of a Λ^0 hyperfragment via the π^+ mode, for the decay of a (Σ^+ p) hyperfragment, for the decay process $\Sigma^+ \rightarrow p + \gamma$, and for the capture of Σ^- with large energy release. (auth)

19697 CEA-1447

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

FLUX NEUTRONIQUE DANS UN MILIEU MULTIPLICATEUR PERTURBE PAR LA PRESENCE DE LAMES PLANES. (Neutron Flux in a Multiplying Medium Perturbed by the Presence of Flat Plates). J. de Lamare, P. Mathelot, and M. Cadhilac. 1960. 30p.

An original method is given for exact calculations of neutron flux in either of two geometries: a slab surrounded by an infinite multiplying medium or a periodical, one-dimensional array of two different media. (auth)

19698 CERN-60-20

European Organization for Nuclear Research, Geneva.

GRAPHS OF LAB.-SPECTRA (AT DIFFERENT ANGLES ($1^\circ, 3^\circ, 5^\circ, 10^\circ, 20^\circ$)) OF PARTICLES PRODUCED IN 25 GeV pp COLLISIONS ACCORDING TO A STATISTICAL THEORY. J. v. Behr and R. Hagedorn. May 6, 1960. 25p.

Graphs from 1 to 40° are drawn on the basis of statistical theory for the spectra of particles produced by 25-Bev proton-proton collisions: the particles covered are γ , π , K , \bar{K} , N , \bar{N} , Λ , $\bar{\Lambda}$, Σ , $\bar{\Sigma}$, Ξ , and $\bar{\Xi}$. The limitations of the graphs and their extension to p-nucleus collisions are given together with the equations for transformation of the spectra into the laboratory system. (D.L.C.)

19699 CERN-60-21

European Organization for Nuclear Research, Geneva.

π -p PHASE-SHIFT ANALYSIS WITH D-WAVES. I. Derado and R. van de Walle. May 10, 1960. 41p.

A set of 8 Mercury-Autocode programs was written for use in interpretation of a π -p scattering experiment with the 30 cm CERN hydrogen bubble chamber. These programs were made sufficiently applicable by taking D-waves into account. A description of the content and application possibilities of such programs is given. (J.R.D.)

19700 CU-197

Columbia Univ., New York. Pupin Cyclotron Lab. and Columbia Univ., New York. George B. Pegram Lab.

THE NEUTRINO—A CONTRIBUTION TO THE MEMORIAL VOLUME TO WOLFGANG PAULI. C. S. Wu. June 1959. 105p. Contract AT-30-1-GEN-72. OTS.

A concise review of the neutrino is presented. Topics discussed include: Fermi theory of beta decay; experimental evidence from classical beta decay; non-conservation of parity; polarized Co^{60} experiment; two-component theory of the neutrino; conservation of leptons; longitudinal polarization of beta particles; β - γ correlation; helicities of leptons and beta interactions; determination of beta interactions from parity experiments; mass of the neutrino; neutrinos and antineutrinos; double beta decay; inverse beta processes; π - μ -e decays; π -e decays; K - μ -e decays; non-conservation of parity in strange particle decay; the Universal V-A Fermi interaction; and the CPT theorem. (W.D.M.)

19701 NAA-SR-Memo-5081

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ANALYSIS OF NEUTRON SLOWING DOWN FROM A FINITE PLANE FISSION SOURCE FOR UNIFORM AND NON-UNIFORM SOURCE DISTRIBUTIONS. H. Alter. Mar. 28, 1960. 21p. OTS.

A method of obtaining a fundamental mode fission source distribution of neutrons is presented. The effect of this distribution is examined, and a method of fission plate size optimization is illustrated. The relative neutron source intensity and slowing down intensity are listed for uniform and non-uniform source distributions for the fission plate radii considered. (J.R.D.)

19702 NP-8711

Joint Inst. for Nuclear Research Dubna, U.S.S.R. Lab. of Nuclear Problems.

SEARCH FOR ρ^0 -MESON AND TEST OF DISPERSION RELATIONS IN PION-NUCLEON SCATTERING. A. D. Konin, S. M. Korenchenko, B. Pontecorvo, and V. G. Zinov. 1959. 15p. (D-455).

Total π^-p cross sections (σ_t^-) were measured with an accuracy of 1.5 to 2% at pion energies ranging from 140 up to 360 Mev. In the energy dependence of σ_t^- there were found no anomalies which might give evidence on the existence of ρ^0 -mesons with mass in the interval 270 to 410 Mev/ c^2 . The data are not compatible with the energy value $E_2 = 650$ Mev for the second maximum in $\sigma_t^-(E)$ discovered by Frish et al., but confirm the conclusion of Brisson et al., that such a maximum is found at a smaller energy ($E_2 = 610$ Mev). The data are in excellent agreement with dispersion relations for (π^-p) scattering. They definitely show that the "Puppi-Stanghellini problem," as such, does not exist any more and that it arose only owing to inexact knowledge of the total cross section of (π^-p) interaction. (auth)

19703 NP-8794

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

DOUBLE MAXIMUM ANGULAR DISTRIBUTIONS IN HIGH ENERGY NUCLEAR COLLISIONS. Report No. 146/VI. (Rozkłady Kątowe z Dwoma Maksimami w Zderzeniach Jądrowych Wysokiej Energii). J. Gierula, M. Mięslowicz, and P. Zieliński. Apr. 1960. 29p.

A statistical analysis of the shape of the angular distribution of secondary particles generated in 65 nuclear collisions for primary energies higher than 10^{12} ev is presented. The double maximum shape of the distribution (in the coordinate $\log \tan \Theta$) exhibited a general feature of the events with high degree of anisotropy of secondaries in c.m. system. It was found that the shape of the angular distribution is in agreement with the predictions of the two-

center model of multiple meson production both for nucleon-nucleon and nucleon-heavy nucleus collision. A parameter D, which is a measure of the deviation from the normal shape of the distribution toward the two-center distribution, and a coordinate for visualizing this deviation are introduced. (auth)

19704 NP-8799

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

INELASTIC INTERACTIONS IN FINAL STATES AND THE THRESHOLD ANOMALIES. L. I. Lapidus and Kuang-chao Chou. 1960. 16p. (D-489).

It is shown that in the energy spectrum of the particle a from reaction $A + B \rightarrow a + C + D$ there may be some anomalies near the threshold of the reaction $C + D \rightarrow E + F$. As an example, the spectrum of K mesons obtained from the reaction $N + N \rightarrow \Lambda + N + K$ is analyzed in the region where the energy of the Λ -N pairs is near threshold of the process $\Lambda + N \rightarrow \Sigma + N$. The well known formula for final state interactions is derived in a simple way. The polarization vectors of the baryons in the final state are calculated when the incident nucleons are polarized. The energy anomalies in the spectrum of final state particle are discussed for some other cases. The production of K-mesons by n-p collisions and case of scalar K-meson are considered. (auth)

19705 NP-8800

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems.

ON NEW STRANGE PARTICLES. B. Pontecorvo. 1960. 5p. (D-501).

Gell-Mann's elementary particle systematics implies the possibility of the existence of two unknown particles, Z^+ ($T = 0$, $S = +1$, baryon number $N = 1$) and D^+ ($T = 0$, $S = 2$, $N = 0$). Present evidence argues against the existence of Z^+ , but one pion interaction in a bubble chamber observed by Wang Kan-chang et al., can be interpreted by assuming a D^+ particle of mass 750 Mev disintegrating thus $D^+ \rightarrow K^0 + \pi^+$ or $D^+ \rightarrow K^+ + \pi^0$. The mean life of such a D^+ would be expected to be 10^{-10} sec, and the conditions for the detection of D^+ with this life are studied. The scheme for this detection would be the registration of produced K mesons with the collimator turned so that it does not view the target. It is shown that a negligible probability of D-particle production will be characterized by the inequality $(K/\pi)_{\text{vacuum}} \ll (K/\pi)_{\text{target}}$. It is concluded that D^+ should form D-nuclei, i.e., systems analogous to hyperfragments in which D^+ may exist in nuclear matter before its decay. (D.L.C.)

19706 NP-8801

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.

FOUR-PRONG DECAY OF A LONG-LIVED K^0 -MESON. E. O. Okonov, N. I. Petrov, A. M. Rozanova, and V. A. Rusakov. 1960. 6p. (D-506).

A four-pronged event was observed in 140 V^0 decay events of long-lived K^0 mesons in the cloud chamber and is ascribed to the decay $K^0 \rightarrow \pi^+ + \pi^- + \pi^0 \rightarrow e^+ + e^- + \gamma$. Assuming the K^0 mass to be 496 Mev, the kinetic energy of the above decay was found to be 80 Mev. The relationship of this decay to earlier observed K^0 decays is discussed. (D.L.C.)

19707 NP-8802

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON THE AXIAL VECTOR CURRENT IN THE LEPTONIC

DECAY OF BARYONS AND MESONS. Kuang-chao Chou. 1960. 17p. (D-514).

The formula of Goldberger and Treiman for the rate of $\pi \rightarrow \mu + \nu$ decay is derived using the analytic property of some matrix element. It is shown that their formula is correct for a wide class of strong interactions including the usual pseudoscalar coupling theory of pions. A formula is obtained which can be used as an experimental test for the adopted assumptions. The leptonic decay of hyperons and K-mesons is treated in a similar way. (auth)

19708 NP-8832

Harvard Univ., Cambridge, Mass.

A THEORETICAL STUDY OF PENDELLÖSUNG FRINGES. PART I. GENERAL CONSIDERATIONS. PART 2. DETAILED DISCUSSION BASED UPON A SPHERICAL WAVE THEORY. Technical Report No. 3. N. Kato. Nov. 10, 1959. 59p. Contract Nonr-1866(39).

The assumption of an incident plane wave is shown to be inadequate for single crystal experiments of x-ray diffraction (Laue case). A dynamical theory of diffraction is formulated for a general type of monochromatic incident wave. Fundamental aspects of wave behavior are discussed in terms of wave bundle considerations. Diffraction phenomena are classified by $\Delta\theta$ (an angular width of single crystal reflection) and Ω_0 (a width in which the angular spectrum of an incident coherent wave takes an appreciable value). If $\Delta\theta \gg \Omega_0$, a plane wave assumption is adequate. This is usually the case for electron diffraction. If $\Delta\theta \ll \Omega_0$, a spherical wave assumption is more appropriate and most x-ray cases fall under this alternative. Furthermore, a criterion is given to distinguish between Fresnel and Fraunhofer diffraction in a crystalline medium. "Pendellösung" fringes of x rays (Kato and Lang, 1959) can be interpreted as Fraunhofer diffraction, while those of electrons are observed in a Fresnel diffraction region. The essential features of section patterns, particularly "hook-shaped" fringes, can now be explained. Based upon this general formulation, explicit expressions for the crystal wave fields and the vacuum wave fields are obtained assuming a spherical wave as the incident beam. For thick parts of crystals, absorption effects are taken into account. The same results as expected from the energy flow theory are obtained as a special case. "Pendellösung" phenomena of x rays are discussed. In particular, "hook-shaped" patterns can be fully explained. Values of integrated intensity due to the ordinary theory do not need to be revised. (auth)

19709 NP-8857

Polish Academy of Sciences. Inst. of Nuclear Research. Warsaw.

ELASTIC SCATTERING OF NUCLEONS AND PIONS AT VERY HIGH ENERGY REGION. (Elastyczne Rozpraszanie Nukleonów i π -Mezonów w Obszarze Wysokich Energii). Report No. 145/VII. Z. Koba, A. Krzywicki, R. Rączka, and Z. Chyliński. Mar. 1960. 32p.

Theoretical considerations concerning the elastic scattering of nucleons and pions in the Bev region are presented. Criteria for the validity of the simplest picture and a formula for constructing the optical potential from known phase shifts are given. The comparison with existing data reveals a sharp discrepancy in the case of p-p scattering at 8.5 Bev. (This has been reported by Veksler in Kiev.) Various possibilities to eliminate this disagreement are discussed: introduction of the real part of phase shifts, for which the dispersion relations would give a direct check, spin-dependence on nuclear interactions, which leads to predominance of the singlet state interaction, and quasi-resonance. (auth)

19710 NP-8864

Florida. Univ., Gainesville.

GAMMA RAY SCATTERING. Sixth Quarterly Technical Progress Report for March 18, 1960 through June 18, 1960. John A. Wethington, Jr. and R. A. Karam. 19p. Contract NOas-59-6013-c.

Gamma radiation scattering experiments are described in which the shielding efficiencies of lead and polyethylene-lead combinations were compared. The results are presented as dose-rate ratios. The thickness of repeated layer combinations of polyethylene lead was varied until the dose rate became equal to the dose rate from a particular lead shield. From these data the mass savings which results from using the repeated layer combination in collimated beam experiments can be estimated. The use of a combination of polyethylene followed by lead reduces the dose rate. Further reductions can be effected by use of the repeated layer configuration. The weight reduction obtained by using a repeated layer combination instead of a lead shield is 10% for shielding a plane source. It is noted that in shielding a source of any shape, the weight of a shield can be reduced if the dimensions of the source exceed a certain limit. The maximum reduction will be no more than 10%. (J.R.D.)

19711 NP-8881

Polish Academy of Sciences. Inst. of Nuclear Research, Krakow.

ÜBER DIE STREUUNG DER THERMISCHEN NEUTRONEN IN DEN WASSERSTOFFENTHALTENDEN MOLEKÜLEN.

(Thermal Neutron Scattering by Hydrogen-containing Molecules). J. A. Janik, J. Janik, S. Kraśnicki, F. Maniawski, A. Murasik, H. Rżany, A. Szkutka, J. Sciesiński, and A. Wanic. 1960. 11p.

The theory of neutron scattering by molecules of molecular gases is verified. The structure of liquids was examined through investigations of experimental deviations of scattering cross sections from the theory. Neutron scattering by polarized molecules and molecules which pass a vibrational energy level in the thermal energy region is considered. (C.J.G.)

19712 NYO-9088

Rochester, N. Y. Univ.

METASTABLE STATES OF HYPERFRAGMENTS AND THE ANOMALOUS MAGNETIC MOMENT OF THE Λ -HYPERON. Syurei Iwao. June 9, 1960. 9p. Contract AT(30-1)-875. OTS.

A method for determining the anomalous magnetic moment of the Λ -particle from observations on the metastable states of hyperfragments is proposed. (C.J.G.)

19713 TID-6081

Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.

QUARTERLY PROGRESS REPORT [FOR] MARCH 1, 1960 TO MAY 31, 1960. Warren F. Goodell, Jr. June 1, 1960. 20p. Contracts AT(30-1)-1932; AT(30-1)-1019; AT-30-1-GEN-72; Nonr-266(72); and N6-ori-110-1. OTS.

Stable operation of the synchrocyclotron since February, construction progress on the high-energy research building and neutron velocity spectrometer flight path tube, and continued work to provide satisfactory optics for the 30-in. propane bubble chamber are reported. Analysis of the decay curve for μ^- mesons stopped in Zn and Nb was continued. Magnetic moments of the muons were measured in a field of 13.8 kilogauss and an r-f frequency of 180 Mcps. The mass of the μ^- was measured by determining the mass absorption in Pb of the phosphorus 3D-2P mesonic x ray. Fine structure splittings were observed in the 2P-1S and

3D-2P transitions of the Pb μ -mesonic atom. Differential cross sections were measured for π^- -carbon scattering at 69.5 and 87.5 Mev and π^- -oxygen scattering at 87.5 Mev and at 20 to 125°C. Preparations were made to measure the capture cross sections of μ^- mesons by protons and to determine the sign of the asymmetry parameter in μ decay. A search was completed for the decay mode $\mu^+ \rightarrow e^+ \gamma$, and muonium ($\mu^+ + e^-$) formation was observed in highly purified Ar gas. The possibility and methods for observing interactions of neutrinos for high-energy, high-intensity accelerators were studied. A general purpose 650 space reconstruction program was written for use with the Columbia bubble chambers and computers. The mass difference of the π^- and π^0 mesons was measured by measuring the momenta of the two internally converted electron-positron pairs from π^0 decay. Scanning and analysis of the 12-in. hydrogen bubble chamber pictures were completed for Cosmotron $\pi^- + d$ interactions and $\pi^- + N^+ \rightarrow \Sigma^- + \theta^0$ events and proposed for the reaction $\pi^- + p^+ \rightarrow \Lambda^0 + \theta^0$. Measurement of the polarization of recoil protons in 600-Mev $\pi^- - \rho$ scattering was proposed to determine the character of the scattering resonance. Extensive slow neutron transmission measurements were made with a flat detector in As, PbI₂, PbBr₂, Mn, Pr₆O₁₁, Tm₂O₃, Cs and Th at 20 ev to 5 kev. Filament scintillation chambers were exposed to the meson beam of the cyclotron. Work was continued on the energy variation of Ag fission and on (p, pn) reactions. (M.C.G.)

19714 TID-6157

College de France, Paris. Laboratoire de Physique Atomique et Moleculaire; Wisconsin. Univ., Madison; and California. Univ., Berkeley. Lawrence Radiation Lab.

METHOD FOR DETERMINING THE K^0 SPIN. Philippe Eberhard and M. L. Good. 1960?. 27p. Contract AT(11-1)-64. OTS.

A method is presented for determining the K^0 spin, using only angular momentum conservation and the rules of quantum mechanics. The method is based on a proof that, in the reaction $\pi^- + p \rightarrow \Lambda + K^0$, the K^0 decay intensity associated with a given direction of the Λ spin cannot be isotropic at any production angle. The particle-mixture aspect of the K^0 and possible magnetic moment precession are considered. (auth)

19715 UCRL-8878

California. Univ., Berkeley. Lawrence Radiation Lab. A SEPARATED 1.17-Bev/c K^- MESON BEAM. Philippe Eberhard, Myron L. Good, and Harold K. Ticho. Aug. 25, 1959. 43p. Contract W-7405-eng-48. OTS.

The design and testing of a 1.17-Bev/c separated K^- beam for use with a 15-in. hydrogen bubble chamber experiment are described. At the target the K^-/π^- ratio was 1/140. At the chamber, after two stages of electromagnetic separation and 4.0 K^- -meson decay lengths, the K^-/π^- ratio was 12.5, corresponding to a total pion suppression by a factor of about 10^5 . The K flux at the chamber was 0.87 K per 10^{10} protons on the target. (auth)

19716 UCRL-9251

California. Univ., Berkeley. Lawrence Radiation Lab. LOW-ENERGY PHOTOPION PRODUCTION FROM PIONS AND NEUTRAL-PION DECAY (thesis). How-sen Wong. June 2, 1960. 38p. Contract W-7405-eng-48. OTS.

The Mandelstam representation is applied to the process $\gamma + \pi \rightarrow 2\pi$. It is shown that a homogeneous integral equation may be obtained for the p-wave amplitude whose solution allows one arbitrary real multiplicative constant, which at present must be determined from experiment. By

the use of crossing symmetry, a simple and tractable approximate solution of the integral equation is obtained. Higher partial waves may be calculated in terms of the p wave. The order of magnitude of the new constant is estimated by considering the decay rate of the neutral pion, in which the amplitude for $\gamma + \pi \rightarrow 2\pi$ plays a prominent role. (auth)

19717

STUDY OF ELASTIC SCATTERING OF He^3 FROM Ne.

J. Catalá, A. García Rodríguez, and J. Aguilar (Universidad, Valencia). Anales real soc. españ. fís. y quím. (Madrid), Ser. A 56, 35-8(1960) Jan.-Feb. (In Spanish)

A program is reported for studying the elastic scattering of He^3 from Ne. Results of experiments on differential cross sections and angular distributions are reported. (W.L.H.)

19718

STUDY OF THE RADIOACTIVITY OF U^{235} BY THE PHOTOGRAPHIC METHOD. J. Catalá and J. Casanova (Instituto de Optica "Daza de Valdes," Valencia). Anales real soc. españ. fís. y quím. (Madrid), Ser. A 56, 57-9(1960) Jan.-Feb.

The radioactivity of enriched U metal was studied using the photographic method. Plates were soaked in a solution of enriched uranium salts, and the range of alpha tracks was measured. (W.L.H.)

19719

SERIES CONVERGENCE IN THE MULTIGROUP THEORY OF NEUTRON DIFFUSION. A. V. Stepanov. Atomnaya Energ. 8, 550-1(1960) June. (In Russian)

Two examples of functions for neutron distribution in heavy (mass number $M \gg 1$) monatomic gaseous moderator are analyzed. It is assumed that the moderating medium consists of alternate plates of thickness 2a and 2b with uniformly distributed monoenergetic neutron sources with non-uniform absorption. The 2a plates contain a homogeneous mixture of moderator nuclei and nuclei with an epithermal resonance region; the 2b plates consist of pure moderator. It is postulated that the resonance absorption nuclei do not alter moderating properties of the medium. The function for neutron distribution from a point source in the confined volume of the uniform mixture of moderator nuclei and nuclei with epithermal resonance absorption was derived. It is postulated that resonance absorbing nuclei do not affect the moderating properties of the medium. Numerical calculations were carried out using graphite and Pu^{238} . Calculations are also made in two-group approximation for the basic harmonics of the distribution function in a spherical moderator with the identical parameters and two radii $R_1 = 62.8$ and $R_2 = 31.4$ cm. The numerical results are tabulated. (R.V.J.)

19720

MODERATION OF A NEUTRON FLUX IN AN IRON-WATER ASSEMBLY. L. A. Gerasova and V. V. Vavilov. Atomnaya Energ. 8, 556-7(1960) June. (In Russian)

Measurements of fission neutron thermalization in a water-iron assembly were carried out in a $74 \times 74 \times 100$ cm steel tank filled with water containing $71.5 \times 71.5 \times 0.3$ cm iron plates. Three specific concentrations of iron were used. The age of neutrons in water was used as a controlling factor. A converter transforming thermal reactor neutrons into a U^{235} fission spectra was used as a source. The spatial distribution of thermalized neutrons was measured with indium foils (mean thickness 40 mg/cm²) enclosed in cadmium. The τ values for energies up to 1.46 ev for various iron-water concentrations (for iron $\tau = 743$

cm^3 , for water $\tau = 30.5 \text{ cm}^2$) are plotted. The data on age of neutrons in the mixtures are in good agreement with calculated values. (R.V.J.)

19721

PRODUCTION OF $\bar{\Sigma}$ -HYPERON BY π -MESONS WITH PULSE OF 8.3 BEV/c. M. I. Solov'ev. *Atomaya Energ.* **8**, 562-3(1960) June. (In Russian)

An analysis of 40,000 photographs of an $8.3 \pm 0.6 \text{ BeV/c}$ π^- beam in a 24 liter propane bubble chamber revealed an event of Σ^- antihyperon decay. A reproduction of the observed tracks is included. The Σ^- production reaction is written as: $\pi^- + c \rightarrow \Sigma^- + K^0 + \bar{K}^- + p + \pi^+ + \pi^+$. The life time of $\bar{\Sigma}$ was found to be $t = (1.18 \pm 0.07) \times 10^{-10} \text{ sec}$. (R.V.J.)

19722

METHOD OF RECORDING LOW-ANGLE X-RAY SCATTERING WHEN INTENSITY SCATTERED BY SPECIMEN CHANGES RAPIDLY WITH TIME. P. W. Teare (Aluminium Labs. Ltd., Banbury, Oxfordshire, Eng.). *Brit. J. Appl. Phys.* **11**, 287-9(1960) July.

A new technique is described for the collection of scattered x-ray intensity data at low angles. The technique is applicable to specimens producing scatter that is time variant. The use of the method is illustrated by an example taken from an age hardening aluminum-zinc alloy. Two methods of recording the intensity data are discussed and it is thought that an improvement in the facility of recording could be obtained by the use of proportional counting. (auth)

19723

FUSION OF PARTICLES IN FUNCTIONAL THEORY. Florence Destouches-Aeschlimann. *Compt. rend.* **250**, 3593-5(1960) May 30. (In French)

A system of two particles with spin is studied in the relativistic functional theory. In some cases such a system has states with constant relativistic waves. Two particles of spin $\frac{1}{2}$ form thus a fused system behaving as a particle with spin 1. From this a physical justification of the formal process of fusion is given. (tr-auth)

19724

FUSION IN FUNCTIONAL THEORY. Jean-Louis Destouches. *Compt. rend.* **250**, 3596-8(1960) May 30. (In French)

The "fused" part of a system of particles is defined, and the wave properties of the fused part are given. The equations for the system are formulated. (tr-auth)

19725

INTERACTIONS OF K^- -MESONS AT REST IN NUCLEAR EMULSIONS. V. THE MULTI-NUCLEON CAPTURE MODE. M. Nikolić, Y. Eisenberg, W. Koch, M. Schneeberger, and H. Winzeler (Universität, Bern). *Helv. Phys. Acta* **33**, 221-36(1960). (In English)

From a complete study of about 1100 K^- -absorptions at rest in nuclear emulsions, it was determined that the multinucleon capture mode forms $37 \pm 5\%$. The energy spectra of the Σ -hyperons were measured and calculated and a separation between Σ -hyperons resulting from single nucleon and multinucleon K^- -captures was performed. Some evidence to the fact that multinucleon captures take place mostly in the heavy emulsion nuclei is presented. A method of determining all the multinucleon reaction rates is suggested and applied to these data. This method makes use of the number and spectra of fast protons emitted from the K^- -capture stars obtained here. The results are compared with the predictions of a model recently proposed. (auth)

19726

INTERACTIONS OF K^- -MESONS AT REST IN NUCLEAR EMULSIONS. VI. THE SINGLE NUCLEON CAPTURE MODE. W. Koch, Y. Eisenberg, M. Nikolić, M. Schneeberger, and H. Winzeler (Universität, Bern). *Helv. Phys. Acta* **33**, 237-54(1960). (In English)

From an analysis of the pion producing events in K^- -captures at rest in nuclear emulsion, the features of the single nucleon K^- -capture mode were studied. Using the pion and Σ -hyperon emission probabilities obtained in the present experiment, and assuming charge independence, all the single nucleon (1N) reaction rates could be determined. Comparing our data to other K^- -absorption experiments, the energy dependence of the 1N matrix elements becomes evident. It is estimated that $63 \pm 5\%$ of K^- -captures leads to a 1N reaction and the rest give rise to multi-nucleon reactions. A study of electrons associated with the K^- -capture stars indicates that a large fraction of the 1N captures takes place in the light emulsion nuclei and that most of the multi-nucleon captures take place in the heavy nuclei. It is also shown that the Σ (or π) charge exchange scattering is small, in contrast to a large Σ -interaction ($\Sigma \rightarrow \Lambda$) cross section. (auth)

19727

ON ZERO MASS MESON-MESON SCATTERING. B. Deo (Ravenshaw Coll., Cuttack, India). *Indian J. Phys.* **34**, 131-40(1960) Mar.

The forward scattering matrix elements for the scattering of two mesons (zero mass) were calculated from pair reproduction cross sections by the method of analytic continuation. These were compared with the Feynman matrix elements to the required order. By comparing the results of the two methods, the value of the counter $\lambda\phi^4$ term was evaluated. (auth)

19728

ON THE ANALYTIC PROPERTIES OF PARTIAL WAVE AMPLITUDES IN YUKAWA POTENTIAL SCATTERING. Daniel I. Fivel and Abraham Klein (Univ. of Pennsylvania, Philadelphia). *J. Math. Phys.* **1**, 274-9(1960) July-Aug.

A new proof is given of the dispersion relation for the l th partial wave amplitude when the potential is of the Yukawa form or (by obvious extension) a suitable linear combination of such forms. The requisite analyticity properties are obtained by rewriting the integral equation for the quantity $f_l(k, r)$, which is related to the l -wave amplitude, as a Volterra equation on a finite interval in which the contribution from the asymptotic part of the integral is absorbed into the inhomogeneous term. The Born series for the inhomogeneous term is analytically continued termwise into the cut complex wave number plane and the uniform convergence of the series is then established utilizing approximations which apply in the asymptotic region. The properties of $f_l(k, r)$ then follow from a well-known theorem on Volterra equations. (auth)

19729

INVARIANT IMBEDDING AND MATHEMATICAL PHYSICS. I. PARTICLE PROCESSES. Richard Bellman and Robert Kalaba (RAND Corp., Santa Monica, Calif.) and G. Milton Wing (Sandia Corp., Albuquerque, N. Mex.). *J. Math. Phys.* **1**, 280-308(1960) July-Aug.

By the use of invariance principles in a systematic fashion, new analytic formulations are developed of the classical particle processes, those of transport theory, radiative transfer, random walk, multiple scattering, diffusion theory, and new computational algorithms which seem well fitted to the capabilities of digital computers. Whereas the usual methods reduce problems to the solu-

tion of systems of linear equations, problems are reduced to the iteration of nonlinear transformations. (auth)

19730

ANALYTIC PROPERTIES OF RADIAL WAVE FUNCTIONS. Roger G. Newton (Indiana Univ., Bloomington). *J. Math. Phys.* **1**, 319-47 (1960) July-Aug.

A review article is presented on the properties of radial wave functions and other quantities relevant to the partial wave analysis of scattering theory, as functions of the energy or wave number. The treatment is restricted to the nonrelativistic Schrödinger equation for two particles with a local potential. In addition to regular and irregular solutions of the radial differential equations, the Jost function, S matrix, and Green's functions are analyzed and completeness is proved. The examples investigated in detail include the Bargmann potentials and their generalizations. (auth)

19731

THEORY OF PHASE TRANSITION IN FERMION SYSTEMS. D. N. Zubov and Yu. A. Tserkovnikov (Steklov Mathematical Inst., Academy of Sciences, USSR). *Nauch. Doklady Vyssheĭ Shkoly. Fiz.-Mat. Nauki* No. 2, 133-40 (1959). (In Russian)

The theory of conductivity was developed previously with a quadrupole Hamiltonian in which electron interactions through the lattice phonon were replaced by direct interactions. The quadrupole Hamiltonian was also used in studies of nuclear matter. The magnitudes in both cases were characterized by similar equations. A system of Fermi particles with direct interaction is analyzed, and a solution for the equations was derived through the use of sufficiently general assumptions. (R.V.J.)

19732

UPPER BOUND ON THE NEUTRON-DEUTERON DOUBLET SCATTERING LENGTH. Larry Spruch (New York Univ. and Univ. of Washington, Seattle), and Leonard Rosenberg (New York Univ.). *Nuclear Phys.* **17**, 30-43 (1960) June (2). (In English)

The method of obtaining upper bounds on scattering lengths is applied to the determination of the n-d doublet scattering length A_D . A new calculation is unnecessary; an analysis of the trial function used by Efimov in a variational estimate of A_D shows that that calculation effectively provides a bound. (The Efimov trial function has the inappropriate normalization for present purposes, but it is exceedingly unlikely that this will alter the character of the present results.) The potentials assumed by Efimov imply $A_D < 1.1 \times 10^{-13}$ cm. If these potentials are accurate, it follows that of the two experimentally allowed sets, namely $A_D = 0.7 \times 10^{-13}$ cm and $A_Q = 6.4 \times 10^{-13}$ cm (Set I), or $A_D = 8.3 \times 10^{-13}$ cm and $A_Q = 2.6 \times 10^{-13}$ cm (Set II), Set I is correct, a conclusion consistent with some recent variational estimates of about 6×10^{-13} cm for the quartet scattering length A_Q . It is also shown, for the general problem, that the exact numerically determined value of the static scattering length lies above the true value if the number of bound state solutions for the static and true problems are the same. (auth)

19733

Tensor and L·S Forces in the Triton. G. H. Derrick (Inst. for Advanced Study, Princeton, N. J.) and J. M. Blatt (Univ. of New South Wales, Australia). *Nuclear Phys.* **17**, 67-73 (1960) June (2). (In English)

A variational estimate is made of the triton binding energy for a potential developed by Gammel, Christian, and Thaler, modified to include L·S forces. This potential,

similar in many respects to potentials based in part on meson theory, is found to be too weak to bind the triton at all; the state of lowest energy is a deuteron and a free neutron. The proportion of P-states coupled in by the L·S forces is less than 0.001 per cent. (auth)

19734

HIGH ENERGY THEOREM IN QUANTUM ELECTRODYNAMICS. Lawrence E. Evans (Johns Hopkins Univ., Baltimore). *Nuclear Phys.* **17**, 163-8 (1960) June (2). (In English)

A theorem of Lehmann, Symanzik, and Zimmermann on the high energy behavior of the meson-nucleon vertex is extended to quantum electrodynamics. It is shown that the vertex function in quantum electrodynamics vanishes in the limit of infinite momentum transfer. This theorem does not necessarily imply the vanishing of the conventional electromagnetic form factors in this limit. (auth)

19735

A NEW METHOD FOR THE SOLUTION OF GROUP DIFFUSION EQUATIONS. A. Foderaro and H. L. Garabedian (General Motors Corp., Detroit). *Nuclear Sci. and Eng.* **8**, 44-52 (1960) July.

The diffusion equations associated with the multigroup, multiregion problem are solved by expansions in eigenfunctions which are solutions of the Helmholtz equation. A determinantal criticality equation is exhibited in which the order of the determinant is independent of the number of groups and which can be solved without recourse to complicated computational procedures. Moreover, the need to fulfill explicitly the requirements that the flux and current associated with each neutron group be continuous across interfaces is eliminated. (auth)

19736

MEASUREMENTS ON THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER FROM 25 TO 296°C. K. S. Rockey and W. Skolnik (Knolls Atomic Power Lab., Schenectady, N. Y.). *Nuclear Sci. and Eng.* **8**, 62-5 (1960) July.

The diffusion length of thermal neutrons was measured in water over the range 25.9 to 295.3°C in the pressure vessel of the KAPL High Temperature Critical Assembly. The diffusion length was determined by fitting an exponential to the data found by activating manganese foils with neutrons from a small Sb-Be source. The temperature variation of the diffusion length could be fairly well represented by either of two simple approximations: either that the transport cross section of water has a $1/v$ behavior, or that the transport cross section is determined from the Radkowsky prescription. (auth)

19737

MEASUREMENTS OF THE TEMPERATURE DEPENDENCE OF THERMAL NEUTRON DIFFUSION PARAMETERS IN WATER AND DOWTHERM A. M. Küchle (Kernforschungszentrum, Karlsruhe, Ger.). *Nuclear Sci. and Eng.* **8**, 88 (1960) July.

The absorption cross section, diffusion coefficient, and diffusion cooling constant of thermal neutrons in water and Dowtherm A (diphenyl-phenyl ether) were measured at various temperatures using a pulsed neutron source. The decay constant of the fundamental mode of the neutron distribution was also measured as a function of the buckling. The data are used to derive the absorption cross section of hydrogen: water, 326 ± 6 mb, and Dowtherm A, 333 ± 5 mb. All possible errors were investigated and found to be smaller than the statistical errors. (D.L.C.)

19738

ON THE INTERACTION OF (200 + 300) MEV K^+ -MESONS IN EMULSION. D. Evans, F. Hassan, K. K. Nagpaul, and N. Shafi (Univ. of Bristol). *Nuovo cimento* (10) **16**, 476-84 (1960) May 1. (In English)

The mean free path for 200 to 300 Mev K^+ -meson reactions with emulsion nuclei other than hydrogen is found to be 60 ± 6 cm. One scatter from hydrogen in 92 m of track length is described and the data on elastic and inelastic reactions are given. No evidence of π -meson production was seen. The nuclear effects of the inelastic reactions are discussed. (auth)

19739

THE SUPERCONDUCTING STATE IN THE BETHE-GOLDSTONE APPROXIMATION. A. Katz, A. de-Shalit, and I. Talmi (Weizmann Inst. of Science, Rehovoth, Israel). *Nuovo cimento* (10) **16**, 485-7 (1960) May 1. (In English)

Using a solvable model for the many-body problem it is shown that the Cooper-type solution to the Bethe-Goldstone equation yields the exact value for the ground state energy of the system. The BCS method yields the ground state energy to order $1/\Omega$. (auth)

19740

A NEW MEASUREMENT OF THE MEAN LIFE OF THE POSITIVE PION. J. Ashkin, T. Fazzini, G. Fidecaro, Y. Goldschmidt-Clermont, N. H. Lipman, A. W. Merrison, and H. Paul (European Organization for Nuclear Research, Geneva). *Nuovo cimento* (10) **16**, 490-504 (1960) May 1. (In English)

The mean life of the positive π meson was determined from about 8000 π - μ decay events recorded by photographing pulses on an oscilloscope and analyzing the data with a fast computer. The value obtained for the mean life of the π -meson is $\tau_\pi = 25.46 \pm 0.32$ nsec. (auth)

19741

A TEST OF APPROXIMATION METHODS IN POTENTIAL SCATTERING. J. D. Bjorken and A. Goldberg (Stanford Univ., Calif.). *Nuovo cimento* (10) **16**, 539-48 (1960) May 1. (In English)

Various approximation procedures in field theory for computing scattering amplitudes are tested on a solvable problem in potential theory, the s -wave scattering by an exponential potential. The methods include: (1) the Fredholm, or determinantal, expansion; (2) the Chew-Mandelstam procedure of constructing the scattering amplitude T_0 from analyticity properties and unitarity; (3) expansion of T_0 in powers of the potential strength λ (Born approximation); (4) expansion of $\tan \delta_0$ in powers of λ , and (5) expansion of $\cot \delta_0$ in powers of λ . Each is carried out in first and second order of approximation and the results are displayed in effective-range plots of $k \cot \delta_0$ vs. energy. In addition, the energies of bound states as predicted by the approximations are compared with the exact result. Approximations (1), (2), and (5) in second order are comparable in accuracy, agree reasonably well with the exact result, and are appreciably better than (3) and (4). The binding energy of the first bound state is predicted well by method (2) in second order, and at best qualitatively by the other methods. All methods except (1) predict existence of bound states for repulsive potentials. In second order method (1) predicts no bound state for any value of λ . (auth)

19742

THE INELASTIC SCATTERING OF ELEMENTARY PARTICLES. [PART] II. G. Feldman, P. T. Matthews, and

A. Salam (Imperial Coll., London). *Nuovo cimento* (10) **16**, 549-55 (1960) May 1. (In English)

An approximate scheme for calculating the inelastic scattering of elementary particles is proposed. The scheme fully incorporates the requirements of unitarity and partially includes causality. When applied to the simple problems of π - p and π - π scattering it reproduces very simply some well known results. (auth)

19743

ON THE INFLUENCE OF WEAK INTERACTIONS ON ELECTROMAGNETIC PROPERTIES OF FERMIONS. A. M. Brodskii (Brodski) and D. Ivanenko (Moscow Univ.). *Nuovo cimento* (10) **16**, 556-9 (1960) May 1. (In English)

Starting from the product of two currents for the description of Fermi-type interactions, a new specific effective kinematic magnetic moment in the equations of particles is obtained for an external variable electromagnetic field. (auth)

19744

THE CANONICAL THEORY OF MOTION OF CHARGED PARTICLES IN EXTERNAL ELECTROMAGNETIC FIELDS. T. Taniuti (Univ. of Copenhagen). *Nuovo cimento* (10) **16**, 572-5 (1960) May 1. (In English)

The canonical equations of motion are derived for charged particles in external electromagnetic fields of such magnitude that Coulomb and particle-radiation interactions may be neglected. The motion is two-dimensional and is separated into two parts, drift and gyration, by a canonical transformation. The effects of drift-gyration interactions are renormalized as an additional drift, and the total hamiltonian is given by the sum of drift and gyration hamiltonians. It is pointed out that solutions should be restricted to conditions in which the drift velocity changes only slowly over the radius of gyration and the averaging time interval. (D.L.C.)

19745

ON MESONIC DECAYS OF THE HYPERNUCLEUS $^3\text{H}_\Lambda$. D. Ivanenko and V. Lulka (Moscow Univ.). *Nuovo cimento* (10) **16**, 582-4 (1960) May 1. (In English)

The decay rates for $\Lambda\text{H}^3 \rightarrow \text{He}^3 + \pi^-$ and $\Lambda\text{H}^3 \rightarrow \text{d} + \text{p} + \pi^-$ were investigated by taking into account the final state interaction between d and p. Only S and P states are considered in the d-p system, and the ratio of the decay rates is computed for each of the two possible spin values for ΛH^3 , $1/2$ and $3/2$. The ratio is found to be between 0.67 and 0.53 for $j = 1/2$ and between 1.42 and 5.31 for $j = 3/2$; the $j = 1/2$ value is in good agreement with the experimental value which is less than one, thus indicating a spin $j = 1/2$ for ΛH^3 . (D.L.C.)

19746

ON THE ENERGY DEPENDENCE OF THE α_{33} -PHASE-SHIFT. G. Höhler (Univ. of Munich). *Nuovo cimento* (10) **16**, 585-6 (1960) May 1. (In English)

The energy dependence of the s - and p -scattering phase shift of the 3-3-amplitude (α_{33}) is derived from the dispersion relations of Chew, Goldberger, Low, and Nambu without the $1/M$ approximation. In the energy range 189 to 525 Mev, it is found to obey the equation $(\sin^2 \alpha_{33}/q^3) = A \exp(-\omega/\sigma)$, where q = pion momentum, ω = total energy minus nucleon mass, $A \sim 47.5$, and $\sigma \sim 0.397$. The applications of this equation are discussed. (D.L.C.)

19747

ACOUSTICALLY MODULATED γ RAYS FROM Fe^{57} . S. L. Ruby and D. I. Bolef (Westinghouse Electric Corp., Pittsburgh). *Phys. Rev. Letters* **5**, 5-7 (1960) July 1.

The relationship between the emission of γ rays by nuclei bound in a crystal and the creation or destruction of phonons was discussed. It suggests that a study of the "off-resonance" line shape in a Mössbauer-type experiment may be used to observe the frequency distribution of lattice vibrations in the crystal. The interactions between phonons and emitting nuclei were investigated by generating low-energy phonons acoustically and studying their effect on γ spectra. The source and absorber were Type-321 stainless steel foils. The source was diffused with Co^{57} . Mössbauer patterns are given for Fe^{57} γ rays emitted by the stainless steel source driven by an π -cut quartz transducer. Progressive disagreement between calculated and experimental curves with higher drive voltages suggests that all the iron atoms did not have the same velocities. (B.O.G.)

1974H

STAR PRODUCTION BY TRAPPED PROTONS IN THE INNER RADIATION BELT. Herman Yagoda (Air Research and Development Command, Bedford, Mass.). *Phys. Rev. Letters* **5**, 17-18(1960) July 1.

The frequency of star production as a function of total number of star prongs is given. This information was obtained from an 1800-gm block of Ilford G5 emulsion which rode an Atlas rocket to a peak elevation of 1176 km. Detection of protons with kinetic energies in excess of 40 Mev was attained. A preliminary study suggested that possible existence of a maximum in the energy distribution at 60 to 80 Mev. The total prong count distribution is compared with star spectra observed at balloon elevations and by Viking rocket trajectories reaching 217 km. (B.O.G.)

1974J

MASS ANALYSIS OF THE SECONDARY PARTICLES PRODUCED BY THE 25-GEV PROTON BEAM OF THE CERN PROTON SYNCHROTRON. V. T. Cocconi, T. Fazzini, G. Fidecaro, M. Legros, N. H. Lipman, and A. W. Merriison (European Organization for Nuclear Research, Geneva). *Phys. Rev. Letters* **5**, 19-21(1960) July 1.

Results are presented of a mass analysis of secondary particles produced in an aluminum target at 15.9° to the 25-Bev proton beam in the CERN synchrotron. Typical spectra for positive and negative particles are shown. The π -meson peak indicates that the time resolution of the apparatus is about 0.9 nanosec. The delays relative to light for a flight path of 27 m are given for pions, K mesons, protons, and deuterons. (B.O.G.)

19750

PRECISE MEASUREMENT OF THE MEAN LIVES OF μ^+ AND μ^- MESONS IN CARBON. R. A. Reiter, T. A. Romanowski, R. B. Sutton, and B. G. Chidley (Carnegie Inst. of Tech., Pittsburgh). *Phys. Rev. Letters* **5**, 22-3 (1960) July 1.

A one inch carbon target was bombarded by 70-Mev π^+ mesons. The muons from π^+ decays were randomly polarized, thus eliminating possible modulation of the decay curve. The weighted average of 14 runs gave a mean life of $2.211 \pm 0.003 \mu\text{sec}$ for μ^+ mesons. The mean life of μ^- mesons was found to be $2.043 \pm 0.003 \mu\text{sec}$. (B.O.G.)

19751

EXTENSION OF THE ISOBARIC NUCLEON MODEL FOR PION PRODUCTION IN PION-NUCLEON AND NUCLEON-NUCLEON COLLISIONS. S. J. Lindenbaum and R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev. Letters* **5**, 24-6(1960) July 1.

It is assumed that the nucleon is excited to an isobaric level which subsequently decays into a nucleon and one or several pions. This model was found to be in reasonable agreement with most of the dominant features of experiments on inelastic π -N and N-N interactions. Reactions are considered which lead to single pion production via N_2^* , the $T = 1/2$ states. Branching ratios were obtained for the various pion-producing reactions for p-p and n-p collisions. (B.O.G.)

19752

THE THEORY OF SCATTERING BY A RIGID ROTATOR. A. M. Arthurs and A. Dalgarno (Queen's Univ., Belfast). *Proc. Roy. Soc. (London)* **A256**, 540-51(1960) July 19.

A theory of scattering by a rigid rotator in which the coupling between the different energy levels of the rotator is taken into account is formulated and explicit expressions, which do not depend upon the magnetic quantum numbers, are obtained for various elastic and inelastic cross sections. Several approximations are described, particular attention being paid to the scattering of heavy particles for which it is shown that at low temperatures the orientation-dependent part of the interaction may be more important than the spherically symmetric part. The scattering of low-energy electrons is also investigated and some representative equations are integrated numerically to illustrate the effect of the orientation dependence. (auth)

19753

DIAMAGNETISM OF ELECTRONS IN A WEAK PERIODIC POTENTIAL. Robert M. May (Univ. of Sydney). *Progr. Theoret. Phys. (Kyoto)* **23**, 400-7(1960) Mar. (In English)

A method recently developed by Blatt, Matsubara, and May for evaluating the magnetic response of a system in a non-gauge covariant approximation is illustrated by a simple example, that of electrons moving in a weak periodic lattice. The result is in quantitative agreement with more detailed gauge-covariant calculations by other authors. The calculation is also of interest in that it provides an example where use of the London gauge, $\text{div} \mathbf{A} = 0$, leads to unphysical results. (auth)

19754

S-WAVE PION-NUCLEON SCATTERING. Ken Kawanabashi and Hironari Miyazawa (Tokyo Univ.). *Progr. Theoret. Phys. (Kyoto)* **23**, 490-5(1960) Mar. (In English)

Low energy S-wave pion-nucleon scattering is reinvestigated based on the following two assumptions: (1) Dilute nucleon-antinucleon pairing extends to a range about $r_0 \approx (2\mu)^{-1}$, where μ is a pion mass. (2) Pion-pion interaction with attractive force contributes to the S-wave pion-nucleon scattering. The main characteristic features of S-wave pion-nucleon scattering are shown to be reproduced under these assumptions and the difficulties inherent in S-wave scattering is made clear in terms of potential scattering. (auth)

19755

S-WAVE PION-NUCLEON INTERACTION AND NUCLEON CORE. Shigeo Minami (Osaka City Univ.). *Progr. Theoret. Phys. (Kyoto)* **23**, 519-21(1960) Mar. (In English)

The dispersion relations for S-wave pion-nucleon scattering are studied in order to examine the role of nucleon structure in the scattering. It is found that the phenomena near the pion cloud, but not those near the nucleon core, can be explained by current pion field theory. This defect can be remedied if a system of dynamics is adopted in which the effective coupling constant g is reduced to $(\mu/2M)g$ in appearance when the dynamics are applied to the problems in the region of a nucleon core, μ and M

being the pion and nucleon masses, respectively. In this way, the experimental S-wave phase shifts can be explained. (D.L.C.)

19756

ON THE TEST OF GLOBAL SYMMETRY. Tetsuro Sakuma and Shinya Furui (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) **23**, 522-4(1960) Mar. (In English)

The absorption of meson (K^-) by protons at low energy is studied in order to test global symmetry. The following assumptions were made: (1) Intermediate K-N states and processes $\pi + \Sigma \rightleftharpoons \pi + \Lambda$ are neglected. (2) Only S-wave interactions are taken into consideration. (3) Global symmetry is valid. The result is that the absorption phase shift, $\delta_1 - \delta_0$, should be zero, in disagreement with the experimental value of $62 \pm 4^\circ$, and this is interpreted as evidence for inconsistency of global symmetry. (D.L.C.)

19757

CHARGE EXCHANGE SCATTERING OF 240-330 MEV π^- -MESONS ON HYDROGEN. V. G. Zinov and S. M. Korenchenko (Joint Inst. for Nuclear Research, [Dubna, USSR]). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1399-1406(1960) May. (In Russian)

Results are presented on measurement of the differential cross sections for charge exchange scattering of 240, 270, 307, and 333 Mev π^- -mesons on hydrogen. (auth)

19758

PHASE SHIFT ANALYSIS OF SCATTERING OF 240-330 MEV π^- -MESONS ON HYDROGEN. V. G. Zinov, S. M. Korenchenko, N. I. Polumordvinova, and G. N. Tentyukova (Joint Inst. for Nuclear Research, [Dubna, USSR]). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1407-18(1960) May. (In Russian)

Results are presented of a phase shift analysis of data on the π meson scattering by nucleons at 240 to 330 Mev. Information on phase shifts for the interaction of π -mesons in states with a spin $T = \frac{1}{2}$ is obtained which is of satisfactory accuracy. (auth)

19759

INVESTIGATION OF POLARIZATION OF INTERNAL CONVERSION ELECTRONS IN TRANSITIONS FOLLOWING β -DECAY OF HEAVY ELEMENTS. M. E. Vishevskiy, V. A. Lyubimov, E. F. Tret'yakov, and G. I. Grishuk. Zhur. Eksptl'. i Teoret. Fiz. **38**, 1424-9(1960) May. (In Russian)

Conversion electron polarization was measured for transitions following β -decay in Tm^{170} , Re^{186} , Hg^{203} , and Pa^{233} . For Tm^{170} and Re^{186} the conversion electrons were found to be polarized in the direction of emission of the β -particles, and for Hg^{203} and Pa^{233} in the opposite direction. The most probable values of the ground state spins of β -decaying nuclei were determined for Hg^{203} and Pa^{233} . The experimental data for Tm^{170} and Re^{186} , for which all transition constants are known, are compared with the theoretical polarization values. (auth)

19760

COULOMB SCATTERING OF CHARGES IN A STRONG MAGNETIC FIELD. Yu. N. Barabanenkov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1512-14(1960) May. (In Russian)

Coulomb scattering of charges in a strong magnetic field when the impact parameter is much larger than the Larmor radius is considered. The solution of the problem indicates that collisions cannot change the plasma electron (ion) distribution function which is symmetric with respect to the transverse (relative to the magnetic field) velocity component. (auth)

19761

ON CALCULATION OF SCATTERING PHASE SHIFTS. V. K. Peterson (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1525-7(1960) May. (In Russian)

A method is proposed for calculating the phase shifts of particles in a centrally symmetric potential field. The case is considered when the phase shift can be expressed in the form of a series in powers of a constant which characterizes the dimensions of the potential well. (auth)

19762

ON THE PREPARATION OF POLARIZED HYDROGEN TARGETS. L. N. Rozentsveig and M. Ya. Azbel (Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1556-8(1960) May. (In Russian)

A method is suggested for obtaining polarized hydrogen targets by polarizing hydrogen dissolved in metal foil. Hydrogen, dissolved in transition group metals, forms hydrides which possess metallic properties and ordered structure. An attempt was made to polarize the protons "diffused" in the metal lattice and to utilize it as a polarized hydrogen target. Scattering on protons is segregated from scattering on metal nuclei by recording the coincidences induced by scattering particles and by recoil protons or by discriminating the scattered particles by energies. A theoretical scheme of measurement is presented which also holds good for tritium and deuterium targets. (R.V.J.)

19763

INVESTIGATION OF THE SPECTRA OF NEUTRONS EMITTED IN THE DISINTEGRATION OF DEUTERONS BY PROTONS. V. V. Komarov and A. M. Popova (Inst. of Nuclear Physics, Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1559-63(1960) May. (In Russian)

The energy spectra of neutrons emitted at angles of 0° and 180° in the c.m.s. from the $p + d \rightarrow p + p' + n$ reaction are calculated for a total energy of the reaction of ~ 4 Mev, including pair interaction of nucleons in the final state. Application of this method for calculation of the energy distributions of reaction products when several particles are emitted is considered from the standpoint of its possible application for ascertaining the role of particle interactions in the final states. (auth)

19764

ANOMALIES OF ELECTRON CHARACTERISTICS IN THE HIGH PRESSURE REGION. I. M. Lifshitz (Inst. of Physics and Tech., Academy of Sciences, Ukrainian, SSR). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1569-76(1960) May. (In Russian)

A peculiar (electron transition) due to variation of the topology of the Fermi surface during its continuous deformation may occur in metals at high pressures. At the point of such a transition the electron state density near the boundary and the electron dynamics possess some peculiar features which lead to anomalies of the electron characteristics of the metal (thermodynamic and kinetic). The most characteristic anomalies in the vicinity of the (electron transition) point at low temperatures are investigated. The possibility of an isomorphic transition of the first kind near the (electron transition) point is discussed. (auth)

19765

SPIN FLIP OF A RELATIVISTIC PARTICLE WITH A MAGNETIC MOMENT MOVING IN AN EXTERNAL FIELD. V. S. Popov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 1584-8(1960) May. (In Russian)

The problem of rotation of the spin of a relativistic

particle with a magnetic dipole moment moving in an external electromagnetic field is solved. The angular velocity of rotation of the spin is determined in the rest system of a particle rigidly fixed to its trajectory (analog of Fresnel trihedron for a four-dimensional curve). The results obtained are significant for experiments involving the measurement of the magnetic and electric moments of elementary particles. (auth)

19766

SINGLE-PHOTON ANNIHILATION AND ELECTRON PAIR PRODUCTION IN A MEDIUM. G. S. Saakyan (Erevan State Univ., Armenian, SSR). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1593-6(1960) May. (In Russian)

Single-photon annihilation and electron pair production $e^+ + e^- \rightarrow \gamma$ may occur in a dispersive medium with a refractive index smaller than unity. In order for such processes to take place the photon energy must lie in the interval $2m \leq \omega \leq N^{1/2}$, where m is the electron rest energy and N is the electron density in the medium. The probabilities for such processes are computed. The physical essence of the effect is similar to that of the Vavilov-Cherenkov effect. The processes under consideration dominate in the energy range $2m < \omega < 10m$. (auth)

19767

LIMITS OF APPLICABILITY OF THE WEAK INTERACTION THEORY. B. L. Ioffe. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1608-14(1960) May. (In Russian)

Weak interactions are assumed to conserve their form at high energies. Then, due to the weak interaction radiative corrections, the equality between the vector interaction constants for β -decay and μ -decay should be violated and $\mu \rightarrow e + \gamma$ and $\mu \rightarrow 3e$ processes should appear. These radiative corrections are computed and by making a comparison with the experiments the upper limit is established for energies up to which the weak interaction theory is valid. (auth)

19768

ON THE D-MESONS. Ting-ch'ang Hsien (Joint Inst. for Nuclear Research, [Dubna, USSR]). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1627-9(1960) May. (In Russian)

The processes most favorable for the production of the D-mesons are discussed. Experiments are proposed to determine the spin and parity of the D-mesons. (auth)

19769

THE POLARIZATION OF RECOIL PROTONS IN π^- MESON SCATTERING IN HYDROGEN AT 300 MEV. I. M. Vasilevskiy and V. V. Vishnyakov (Joint Inst. for Nuclear Research, [Dubna, USSR]). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1644-6(1960) May. (In Russian)

The polarization of recoil protons in 300-Mev π -meson scattering by hydrogen was measured. 305 events of elastic π -meson scattering and proton scattering in the hydrocarbon target or in the counter walls were divided into three groups according to the angle of recoil protons. The obtained data are tabulated, and the polarization as a function of the π -meson scattering angle for two sets of phases was plotted. (R.V.J.)

19770

ON THE NON-RADIATIVE TRANSFORMATION OF A μ MESON INTO AN ELECTRON. I. S. Shapiro. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1646-7(1960) May. (In Russian)

The process of non-radiative transformation of μ^- mesons into electrons in a nuclear Coulomb field $(1) \mu^- + A_Z \rightarrow A_Z^* + e^-$ should prove more feasible than $\mu \rightarrow e + \gamma$ decay when the monopole form factor of μ -e transition is larger

than the dipole. S. Weinberg et al. (Phys. Rev. Letters **3**, 111(1959)) showed an example of four-fermion interaction of the $(\bar{e}\mu)$ ($\bar{f}f$) type (where f is a charged particle), which supports the process (1). Another method used recordings of 100-Mev electrons. In order to find another method of showing reaction (1), an analysis is made of μ -mesic atoms with light even-even nuclei (C^{12} , O^{16} , or Ne^{20}) which at 6 to 10 Mev excitation are in state 0^+ and which emit α particles in decay. The suggested method consists of detecting α particles of certain energies emitted by nuclei at the 0^+ level as a result of Coulomb excitation of the mesic atom. Such a phenomenon is rare due to the small phase volume. The probability ratio for $\mu^- + A_Z \rightarrow A_Z^* + e^-$ to $\mu^- + A_Z \rightarrow A_Z-1 + \nu$ is evaluated to approach 1. (R.V.J.)

19771

DIRECT REDUCTION OF ELASTIC SCATTERING AMPLITUDE. G. I. Kopylov and Z. D. Lomakina (Joint Inst. for Nuclear Research, [Dubna, USSR]). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1649-51(1960) May. (In Russian)

An attempt is made to find a method for solving the simple scattering matrix of spin-zero particles in the power center. A system of equations was derived for virtual $R(\mu)$ and imaginary $I(\mu)$ ($\mu = \cos \theta$) parts of the scattering amplitude. The selection of functions $I(\mu)$ and $R(\mu)$ is preferable to the previously described complex amplitude because of its modulus and phase. The latter is unstable to small variations of the amplitude. Application of the theory of generalized functions secures convergence even in the case of a non-coincident number of zeros in the solution and in zero approximation. Numerical results show the feasibility of a direct solution to the non-linear equation systems for more complex scattering events with spin, without resorting to phase analysis. (R.V.J.)

19772

ABOUT THE NEW STRANGE PARTICLES. B. Pontekorvo (Pontecorvo) (Joint Inst. for Nuclear Research, [Dubna, USSR]). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1654-6(1960) May. (In Russian)

The existence of new strange particles $Z^+(T=0, S=+1, \text{barion number } N=1)$ and $D^+(T=0, S=+2)$ is discussed. Recently an event of π -meson interaction in a bubble chamber was reported which indicated the presence of D^- particles with mass ~ 750 Mev decaying as $D^- \rightarrow K + K^0 + \pi^-$ or $D^- \rightarrow K + K^- + \pi^0$. It is assumed that the lifetime of the hypothetical particle is 10^{-10} sec and cannot be detected by ordinary methods. The unique feature of K emission during its decay is utilized by recording the K mesons produced by D decay in a vacuum near the bombarded target. The relative probability of D-particle formation can be expressed by $(K/\pi)_{\text{vac}} \ll (K/\pi)_{\text{target}}$. Assuming that the number of D mesons is $\sim 10^{-4}$ of the number of interactions induced by 10-Bev protons and the number of K mesons is $\sim 10^{-2}$ of these, then 1% of the total K-meson flux has the D-meson property. Analyses were made of the methods and the data recorded. (R.V.J.)

19773

ON THE SCATTERING OF ELECTRONS ON LIGHT ATOMS. A. N. Pilyankevich (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian, SSR). *Zhur. Tekh. Fiz.* **30**, 226-31(1960) Feb. (In Russian)

The atomic scattering factor characterizing the angular distribution of elastic (coherent) electron scattering and the scattering function of inelastic (incoherent) electron scattering were analyzed. Data obtained for small angle scattering differ from published data while the data for

medium and large angles coincide with those published. In small-angle scattering by light atoms the inelastic scattering is several orders higher than the elastic, and with the $\sin \theta/\lambda = 0.1$ the intensity of the elastic and inelastic scattering have identical values. (R.V.J.)

19774

THE ENERGY LOSS OF A BREMSSTRAHLUNG BEAM FROM CALORIMETRIC ABSORBER. S. P. Kruglov and I. V. Lopatin (Inst. of Physics and Tech., Academy of Sciences, Leningrad). *Zhur. Tekh. Fiz.* 30, 424-32(1960) Apr. (In Russian)

The angular distribution of energy loss was measured with various calorimetric absorbers. The angular distributions were determined by the small-angle radiation loss and by absorption in lead. For lead absorbers with $E_{\gamma \text{ max}} = 85$ Mev the albedo energy was 1.5%. A further reduction of energy losses can be achieved with Faraday cylindrical absorbers. (tr-auth)

19775

REFLECTION OF AN ELECTROMAGNETIC WAVE FROM MOVING SURFACE. V. I. Kurilko (Inst. of Physics and Tech., Academy of Sciences, Khar'kov). *Zhur. Tekh. Fiz.* 30, 504-7(1960) May. (In Russian)

Quantitative analysis is made of the phenomena related to multiple reflection of electromagnetic waves. A simplified case of a non-stationary process in a space limited by two ideally conducting planes moving toward each other with a given velocity v is analyzed as one of the processes in colliding volumes containing an electromagnetic field. The problem is reduced to the resolution of the Maxwell equation for an electromagnetic field in a medium with given E and μ . The developed formulas permit determination of the field at any point between planes at any time. (R.V.J.)

19776

THE THEORY OF CAPTURE OF PARTICLES INTO THE SYNCHRONOUS ACCELERATING REGIME TAKING INTO ACCOUNT THE NON-CONSERVATISM OF THE MOVEMENT EQUATION. Yu. S. Sayasov and V. K. Melnikov (Inst. of Chemical Physics, Academy of Sciences, Moscow). *Zhur. Tekh. Fiz.* 30, 656-64(1960) June. (In Russian)

Detailed calculations of the capture region are made with consideration of non-conservation in the equation $d/dt[m(t)\dot{\psi}] + f(t)U'(\psi) = 0$, where $U'(\psi) = du/d\psi = -1/\sin\psi [\cos(\varphi_s + \psi) - \cos\varphi_s]$, φ_s is the synchronous phase, and ψ is the phase difference of the examined and synchronous particle. Slow changes in $f(t)$ and $m(t)$ are assumed, considering that the time τ of $f(t)$ and $m(t)$ is large in comparison to the period of linear phase oscillations. Thus, the above equations written as $d/dt[m(\epsilon t)\dot{\psi}] + f(\epsilon t)U'(\psi) = 0$, where $\epsilon = 2\pi/\tau\Omega$, is analyzed. (R.V.J.)

19777

THE CAPTURE OF ELECTRONS BY PROTONS IN NOBLE GASES. V. V. Afrosimov, P. H. Il'in, and E. S. Solov'ev (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 705-10(1960) June. (In Russian)

Total cross sections for electron capture by protons in He, Ne, Kr, and Xe and for two-electron capture by protons in Ar were measured at energies of 10 to 180 kev. It is shown that the cross section for two-electron capture diminishes faster with the increase of energy than the cross section for single electron capture. The angular distribution of fast H atoms and H^+ ions produced by proton capture of one and two electrons and the angular distribution of protons scattered in argon without charge variation are also investigated. It is postulated that the capture of two

electrons is achieved by closer contact between protons with atoms than that in one electron capture. (tr-auth)

Nuclear Properties and Reactions

19778 AD-231528

Catania, Italy. Università. Istituto di Fisica and Italy.

Centro Siciliano di Fisica Nucleare, Catania.

TOTAL NEUTRON CROSS SECTION FOR PHOSPHORUS AND CROSS SECTION FOR THE $P^{31}(n,p)Si^{31}$ REACTION WITH NEUTRON ENERGY FROM 3 TO 5 MeV. Technical Final Report. S. Cavallaro, P. Cuzzocrea, G. Pappalardo. R. Ricamo, and F. Vinci. [1959?] 24p. Contract AF61(052)-37.

The total cross section of P^{31} and the cross section for the reaction $P^{31}(n,p)Si^{31}$ were measured for neutrons in the energy range from 3 to 5 Mev with an average uncertainty of ~ 80 kev. The behavior of the cross sections was similar to that observed by Grund. Morita, and Ricamo, a resonance peak being found at 3.17 Mev as expected; however, additional peaks were found at 3.78, 4.47, and 4.74 Mev, the former being well defined. (D.L.C.)

19779 AD-231851

Brookhaven National Lab., Upton, N. Y. and Illinois. Univ., Urbana.

EFFECT OF THE FINITE NUCLEAR SIZE ON INTERNAL CONVERSION. Technical Memorandum M60-10-1. E. L. Church and J. Weneser. Nov. 1959. 13p. Sponsored by Ordnance Materials Research Office; Office of Naval Research; and the Atomic Energy Commission under DA Project No. 599-04-001. OTS.

It is shown that the finite nuclear size introduces additional nuclear matrix elements into the expression for the rate of internal-conversion-electron ejection which are distinctly different from that for gamma-ray emission of the same multipole order. To illustrate the effect of these new matrix elements, the correction to the K-conversion coefficient of magnetic-dipole transitions is calculated. It is shown that in cases where the gamma-ray matrix element is attenuated (e.g., 1-forbidden M1 transitions and the M1 components in odd-A rotational transitions), the new nuclear matrix elements may lead to appreciable deviations between the experimentally measured K-shell conversion coefficient and the theoretical calculations of Sliv. The conversion coefficients of other electric and magnetic transitions are also affected by the introduction of the new matrix elements, as well as angular-correlation measurements involving the conversion electrons. (auth)

19780 AERE-M-640

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AVERAGE ELECTRON ENERGY IN BETA DECAY. M. F. James, B. G. Steel, and J. S. Story. Mar. 1960. 20p. BIS.

The ratios of average to maximum kinetic energy of electrons emitted in beta transitions are tabulated. Allowed and unique forbidden spectra of 1st and 2nd orders are considered. The tables cover $Z = 2, 10, 20, \dots, 90$ (Z being the atomic number of the daughter nucleus), and the energy range 0.02 to 7 Mev. (auth)

19781 AFOSR-TN-60-295

Universidad de Cuyo, San Carlos de Bariloche, Argentina.

Instituto de Física; Buenos Aires. Universidad.

Facultad de Ciencias Exactas, Físicas y Naturales; and Sweden. Kungliga Vetenskapsakademien. Nobelinstitutet för Fysik, Stockholm.

THE OSCILLOSCOPE METHOD OF MEASURING NUCLEAR HALF-LIVES. Technical Note No. 2. I. Bergström, E. Bonacalza, A. Jech, M. Perez, and P. Thieberger. Feb. 1, 1960. 39p. Contract AF61(052)-118.

It is shown that the modern fast oscilloscopes now available commercially, are very simple and powerful tools for measuring nuclear half lives. The advantages and the limitations of the method are discussed. In order to illustrate the problems which are associated with measurements in different half-life regions, seven half lives associated with metastable states in the following nuclei were measured: Pb^{205} (4.0 ms), Pb^{206} (125 μ s), Ta^{181} (17.5 μ s), Sr^{85} (1.0 μ s), Pb^{204} (302 μ s), Pb^{203} (55 μ s), and Ta^{181} (11 μ s). The half lives measured thus cover a half-life ratio of almost $10^6:1$, but it is felt that in favorable cases this ratio might be as large as $10^8:1$. Thus the oscilloscope method can be used in the whole region where conventional delayed coincidence technique is applicable. It is significant for the usefulness of the method that when studying half lives which were reasonably well known and only chosen for the purpose of investigating the oscilloscope method itself, a new half-life was discovered in one of the samples used (Pb^{203}). An advantage of the oscilloscope method is that above about 1 μ s it can be used as a multi-channel time analyzer, by continuously photographing the events on the oscilloscope screen. (auth)

19782 AFOSR-TN-60-463

Johns Hopkins Univ., Baltimore.

AUGER RATE IN μ MESIC ATOMS. A. Pevsner, R. Strand, L. Madansky, and T. Toohig. May 1960. 10p. Contract AF18(603)-143.

A study was made of the K Auger transitions in the light elements of nuclear emulsions. Of 3382 stopping μ -mesons, 1016 were observed to decay. Five of these had associated short-range electrons whose energies were consistent with the K transitions of CNO. Two of these 5 were attributed to the K Auger transitions of CNO, while the remaining 3 were attributed to higher Auger transitions in AgBr. These results are compared with the calculations of Burbidge and de Borde, which predict 1.3 K Auger electrons from CNO for this experiment. These experimental results are inconsistent with the assumption that the missing K radiative transitions in the experiment of Stearns and Stearns are due to competing Auger processes, since this would require 294 observed K electrons as compared to the 2 actually observed. The experimental results quoted here are in agreement with the experiment of Fry. (auth)

19783 CF-58-9-43

Oak Ridge National Lab., Tenn.

KINEMATICS OF NUCLEAR REACTIONS CALCULATED WITH THE IBM 704 COMPUTER. B. D. Williams. [Sept. 1958]. 10p. OTS.

An IBM-704 program is described for calculating certain kinematic quantities for any nonrelativistic reaction of the form $i + t \rightarrow o + r$. The following are computed for each product particle as a function of center-of-mass angle: laboratory angle, solid angle transformation, laboratory energy, reciprocal of velocity, and magnetic rigidity times atomic charge. A sample output sheet is reproduced, for inelastic scattering of N^{14} by C^{12} to the 2.31-Mev excited state in N^{14} . (W.D.M.)

19784 CU(PNPL)-200

Columbia Univ., New York.

INTERACTION OF NEUTRONS WITH He^3 (thesis). Alden R. Sayres. Mar. 7, 1960. 90p. Contract AT-30-1-GEN-72. OTS.

A proportional counter was designed and constructed to

be used as a neutron spectrometer by means of a He^3 filling. A description is given both of the vacuum system, designed for the purification of the counter filling, and the construction and operation details of the spectrometer. Spectra of the $n + He^3$ reactions were obtained for monoenergetic neutron fluxes of 0.95, 2.67, 5.00, 8.07, and 17.5 Mev. Analysis of these spectra then yielded the ratios to the total cross section of the total elastic, the $He^3(n,p)H^3$, and the $He^3(n,d)D$ reaction cross sections. Absolute cross sections were obtained by normalization to the known total cross section. Differential elastic scattering cross sections for neutrons on He^3 were obtained through the relationship between the scattering angle of the neutron and the observed energy of the He^3 recoil in the counter filling. These angular distributions are compared with the theoretical angular distributions. The experiment was intended to discriminate between two special cases for the potential interaction; the symmetrical exchange force and the Serber exchange force. The experimental results favor the Serber exchange force. The experiment also was intended to make possible the analysis of more complex neutron spectra by providing knowledge of $n + He^3$ reaction cross sections and the spectra obtained when only monoenergetic neutrons are present. A comparison is made of the results of this experiment with cross sections calculated from inverse reactions and direct measurements of other investigators, where such data are available. (auth)

19785 INSJ-29

Tokyo Univ. Inst. for Nuclear Study; Tokyo Inst. of Tech; and Yokohama National Univ., Japan.

NUMERICAL DIFFERENTIAL CROSS SECTIONS OF ELASTIC AND INELASTIC SCATTERINGS OF PROTONS. II. BY MAGNESIUM AT THE ENERGY RANGE FROM 7 MeV TO 16 MeV. N. Yamamuro, S. Kobayashi, K. Matsuda, Y. Oda, and Y. Nagahara. Apr. 11, 1960. 15p.

Values for the differential cross sections of proton scattering by magnesium are given. The energy range covered was 7 to 16 Mev. The relative and absolute errors are given. (W.D.M.)

19786 NP-8784

Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas. NOTE ON THE EFFECTS OF POLARIZATION OF AN INCIDENT PHOTON BEAM ON THE AZIMUTHAL ANGULAR DISTRIBUTION OF THE (γ, N) REACTION PRODUCTS. A. G. de Pinho Filho. 1959. 15p. (Notas de Física Vol. V, No. 18).

19787 NP-8803

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON A SUPERFLUID MODEL OF A NUCLEUS. V. G. Solov'ev (Soloviev). 1960. 8p. (D-515).

The superfluidity and superconductivity theory based on Bogoliubov's mathematical procedures is useful for the description of medium or heavy nuclei, whose ground states are called superfluid nuclear states. A superfluid nuclear model is developed from shell and unified models, taking into account the residual nucleon interactions near the Fermi surface energy of a nucleus. To serve as examples, the strongly deformed nuclei among the rare earths are considered on the basis of the Nilsson potential and adiabatic approximation. Both even and odd nuclei are included. The results are: (1) energy levels of Dy^{160} , (2) neutron pairing energy of Yb^{174} , (3) proton pairing energy of Hf^{178} , (4) corrections to beta decay of Er^{163} , Dy^{165} , and Ho^{167} , and (5) corrections to E1 transition of Dy^{161} . It is concluded that this model is capable of calculating the excitation spectra, pairing energies, inertia moments of ground and

excitation states, corrections to probability of β - and γ -transitions, etc. (D.L.C.)

19788 NP-8826

Weizmann Inst. of Science, Rehovoth, Israel.

ENERGY LEVELS AND CONFIGURATION INTERACTION IN Zr^{90} AND RELATED NUCLEI. I. Talmi and I. Unna.

[1959?]. 35p.

Proton and neutron $p_{1/2}$ and $g_{7/2}$ configurations (and in particular the interaction of the two 0^+ states in Zr^{90}) are considered without any specific assumptions on the two-body nuclear interaction and radial functions. Matrix elements of the effective nuclear interaction are determined by the analysis of energy levels in Zr^{90} and several neighboring nuclei (e.g., Sr^{86} which has the same configurations). Good agreement is obtained between calculated and experimental level spacings. The one nondiagonal matrix element is determined along with the diagonal elements and the amount of admixture is calculated in all cases. The ground state of Zr^{90} is found to be 75% in the $p_{1/2}^2$ configuration and 25% in the $g_{7/2}^2$ configuration in agreement with the rough experimental findings. The seniority is found to be a good quantum number for the effective interaction obtained in the $g_{7/2}$ shell of identical nucleons. This interaction gives rise to the low lying $1/2^+$ level in Sr^{85} . Level schemes predicted by the present calculation are given for several nuclei. (auth)

19789 NP-8849

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

STUDIES ON THE ATOMIC NUCLEUS STRUCTURE WITH REACTOR WWR-S BY I-A DEPARTMENT OF ATOMIC NUCLEUS PHYSICS OF THE INSTITUTE OF NUCLEAR RESEARCH. Z. Wilhelmi. 1960. 23p.

Studies of neutron interactions with nuclei and beta and gamma spectroscopy were carried out using the "EWA" reactor. Studies of resonance scattering of gamma radiation were begun. Gamma and neutron spectra from the horizontal channel of the reactor were measured. Cross sections for potential scattering of neutron beams were measured for Al, Fe, Co, Ni, Cu, Zn, Se, Ag, and Bi. Studies of fission followed by the emission of a high-energy, 8 to 30 Mev, alpha particle were continued. Energy distribution studies of "tripartition" of U^{235} and Pu^{239} showed wide variations from "double" fission processes. Gamma transition energies of 158 and 370 keV were observed for the 44 min isomer of Hg^{199} . Beta-gamma angular and energy correlations of Ne^{23} were studied to determine the nature of coupling in beta decay. Neutron choppers, soon to be installed in the laboratory, are described. (M.C.G.)

19790 NP-8858

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

GAMMA SPEKTR Tm^{167} . (Gamma Spectrum Tm^{167}). Report No. 136/I-A. S. Khoznatski, A. Yasiniski, V. Kush, Ya. Kovnatski, G. Lantsman, and I. A. Yutlandov. Mar. 1960. 13p.

The γ spectrum of Tm^{167} was investigated with a scintillation spectrometer. Gamma transitions at 208 and 527 keV were confirmed, and the relation between their intensities was estimated to be $(527):(208) = 0.059 \pm 0.005$. The results obtained are in agreement with spin $5/2$ and odd parity of the 735-keV level in Er^{167} . (tr-auth)

19791 NYO-7336

Columbia Univ., New York.

PROGRESS REPORT AND BUDGET PROPOSAL. J. M. Miller. June 1960. 6p. Contract AT(30-1)-1019. (CU-30-60-AEC-1019-Chem.). OTS.

The excitation functions for the (α,n) , (α,p) , (α,pn) , $(\alpha,3n)$, and $(\alpha,\alpha n)$ reactions of Sn^{124} were measured for alpha energies of 15 to 40 Mev, along with the cross sections for the production of the isomers of Te^{127} , Sb^{126} , and Sn^{123} in the above reactions, and the results are discussed in terms of the statistical theory of nuclear reactions. The excitation functions for the (α,n) , $(\alpha,2n)$, $(\alpha,2p)$, $(\alpha,2pn)$, $(\alpha,\alpha n)$, and $(\alpha,\alpha 2n)$ reactions of Sc^{46} were also measured for alpha energies of 10 to 40 Mev, and the results are in good agreement with evaporation theory. Fission of silver by protons was studied by measuring the cross sections of the product formation for proton energies of 86 to 380 Mev. A precise investigation of (p,pn) and $(p,2p)$ reactions induced by 380-Mev protons was carried out. The product of the strong reduction of ReO_4^- was studied and found to be a hydride of rhenium in a positive oxidation state with seven hydride ions per rhenium ion. The chemical effects of neutron capture in cis- and trans- $[Co(en)_2Cl_2]NO_3$ were studied; after one isomer was irradiated, no appreciable amount of Co^{60} or Cl^{38} was found in the form of the other isomer even after annealing. Activation energies were computed for the Co^{60} and Cl^{38} annealing processes, and the increase in retention of Co^{60} and Cl^{38} is discussed. The compound nucleus model was tested by forming Cu^{63} in two different ways, alpha reactions with Co^{59} and proton reactions with Ni^{62} , and by measuring the cross sections of the various decay modes of the excited Cu^{63} nucleus; the results vindicate the model. The proposed course of research for the ensuing year at Columbia University is outlined. (D.L.C.)

19792 ORNL-2950

Oak Ridge National Lab., Tenn.

PSEUDOSCALAR INTERACTION IN NUCLEAR BETA DECAY (thesis). Chander P. Bhalla. July 11, 1960. 188p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tennessee.

Experiments on allowed β transitions, which provided virtually a unique interpretation of the beta interaction in the form of the V-1.2A law, shed no light on the question of the possibility of a contribution from the pseudoscalar interaction. In order to determine whether such a contribution was really needed, the $0 \rightarrow 0$ (yes) beta transitions were examined. The only relevant experimental data were the β longitudinal polarization and the β spectrum. Using the form of the pseudoscalar interaction, which results from the Foldy-Wouthuysen transformation, the β longitudinal polarization, resulting from the A and P mixture, was calculated. The calculated β polarization and β shape factor depended on two parameters, the ratio of the coupling constants of the P and the A interactions and the ratio of the nuclear matrix elements. The β longitudinal polarization and the β shape factor for Pr^{144} ($0^- \rightarrow 0^+$) and Ho^{166} ($0^- \rightarrow 0^+$) were tabulated considering the nucleus to be a sphere of a uniform charge distribution with the nuclear radius as $1.2 A^{1/3} 10^{-13}$ cm and properly taking into account the finite de Broglie wavelength effect. An extensive numerical analysis of the accurate experimental data on Pr^{144} ($0^- \rightarrow 0^+$) was carried out. The β^- longitudinal polarization measurement of Mehlhop et al., the β^- shape factor of Porter and Day, and the β^- longitudinal polarization measurement of Ho^{166} due to Bühring were investigated. Conclusions drawn were that the absence of the pseudoscalar interaction was consistent with the existing experimental data and that the upper limit on $|C_P/C_A|$, which also gave a fit to the experimental data, was 90 or about half the previous estimate as appeared in the literature. The assumptions made were: time reversal invariance for the strong as well as for the weak

interactions was valid and the two component theory of the neutrino was used. Accurate measurements of the β longitudinal polarization (with an accuracy $\sim 1\%$) at four or five different beta momenta and the beta shape factor in the $0 \rightarrow 0$ (yes) transition could settle the question of the existence of the pseudoscalar interaction in the nuclear beta decay. (auth)

19793 TID-6074

Purdue Research Foundation, Lafayette, Ind.
RESEARCH IN NUCLEAR PHYSICS PROGRESS REPORT
No. 10. June 15, 1960. 41p. Contract AT(11-1)-122. OTS.

Installation of a remotely controlled arc in the cyclotron and a particle spectrograph was completed. Angular distributions were measured for the reactions $C^{12}(He^3,p)N^{14}$ and $C^{12}(He^3,d)N^{13}$ using the cyclotron 14-Mev He^3 beam. Angular distribution measurements of proton groups from (α,p) reactions started on F^{19} were extended to include Na^{23} , Al^{27} , and Si^{28} . Scattering of 18-Mev alpha particles by C, O, Ne, S, and Ar was investigated. A search was made for higher-order effects in allowed beta decay. Under certain conditions, the relative contributions of p and d waves by virtue of their interference with s waves could become large enough to lead to measurable effects. An attempt was made to detect a small anisotropy in an allowed $\beta-\gamma$ directional correlation with Na^{22} , Sc^{46} , Co^{60} , and Na^{24} . The $\beta-\gamma$ angular correlation measurements with Sb^{124} were evaluated to obtain the magnitude of the nuclear matrix elements. A similar determination was made for the 1.6-Mev beta transition. Angular dependence of the circular polarization of the 0.603-Mev gamma radiation following the first forbidden beta decay of Sb^{124} was also determined. The degree of transverse polarization of the K-conversion electrons following the first forbidden beta decay of Hg^{203} was measured. A scintillation positron spectrometer was modified so that coincident detection of the two annihilation quanta as well as the following gamma ray was required before the positron pulse was analyzed. The positron spectrum associated with the decay of Y^{88} was studied before and after modification of the spectrometer. Bombardment of high-purity magnesium with He^3 yielded a positron-emitting isotope with a half life of 2.1 ± 0.3 sec. Studies indicated it was Si^{28} produced by the reaction $Mg^{24}(He^3,n)$. When high-purity silicon was bombarded, studies indicated the production of a new isotope S^{30} with a half life of 1.4 sec. The decay of Y^{91} was studied using NaI(Tl) scintillation counters. Two permanent-magnet electron spectrographs were constructed and calibrated. The gamma spectra of 30-sec Rh^{106} and 8.3-day Ag^{106} , both of which decay to Pb^{106} , were studied. (M.C.G.)

19794 TID-6080

Ohio State Univ. Research Foundation, Columbus.
STUDY OF COMPLEX BETA DECAY SPECTRA. Report
No. 4 (Progress) [for] May 16, 1959–May 15, 1960. M. H. Kurbatov and J. D. Kurbatov. June 1960. 133p. RF Project 713. Contract AT(11-1)-469. OTS.

Investigations were carried out on all three modes of beta decay. The continuous electromagnetic radiation emitted by nickel-59, due to electron capture decay, was re-investigated with improved techniques. It was established that the shape of the spectrum was not consistent with an allowed shape but was fitted to a second forbidden transition after appropriate corrections for Compton scattering and scintillation efficiency. The decay of bromine-76 was investigated for its complex positron spectrum. Beta-gamma coincidences, gamma-gamma coincidences for verification of intensity of population of energy levels in

the daughter product, and comparative analyses by subtraction of the total spectrum were studied to obtain a complete picture of beta decay. To determine whether the 1.02 and 1.26 Mev energy levels of selenium-76 exist, a separate investigation of the gamma coincidences was made for possible gamma emission from these levels. For a comparative study of the energy levels of selenium-76 appearing in the disintegration of bromine-76 and arsenic-76, the beta decay of arsenic-76 was also investigated. The results of beta decay studies of bromine-77 and gamma-gamma coincidences of selenium-77 from the decay of bromine-77 yielded a scheme of disintegration which is reported. Similarly the decay of cerium-144 was investigated by means of beta-gamma and gamma-gamma coincidences. Energy levels in praseodymium of 58, 80, 100, and 134 kev were established. A carrier free separation of bromine from selenium or arsenic targets was developed using an anion exchange resin. A procedure using nitric and hydrochloric acids for the isolation of carrier free rhodium from ruthenium targets was developed. The complex positron spectrum of the 16.1 day isomer of rhodium-99 was investigated with a thick lens spectrometer and a crystal scintillation coincidence spectrometer. Energy levels in ruthenium-99 of 90, 319, 340, 439, 615, and 630 kev were deduced from the decay of two isomers, 16.1 day and 4.6 hr, of rhodium-99. (M.C.G.)

19795 UCRL-5226(Rev.)(Pt. I)(Vol. III)

California. Univ., Livermore. Lawrence Radiation Lab.
TABULATED NEUTRON CROSS SECTIONS. PART I.
0.001–14.5 Mev. Robert J. Howerton. Oct. 1959. 252p.
Contract W-7405-eng-48. OTS.

Tables of neutron cross sections for various elements at energies of 0.001 to 14.5 Mev are presented. (C.J.G.)

19796 UCRL-8740

California. Univ., Berkeley. Lawrence Radiation Lab.
I. BETA-SPECTROSCOPIC STUDIES IN THE PROMETHIUM REGION. II. THE CORIOLIS INTERACTION IN DEFORMED NUCLEI (thesis). Thomas V. Marshall. May 1960. 74p. Contract W-7405-eng-48. OTS.

The isotopes Sm^{142} and Pm^{142} were produced by the reaction sequence: $Nd^{142}(\alpha,4n)Sm^{142} \xrightarrow{\beta^+, EC} Pm^{142}$. The decay characteristics of these isotopes were determined. The gamma, beta, and conversion-electron spectra of Pm^{149} were measured and a decay scheme is proposed for this isotope. A method for calculating the effect of the Coriolis interaction on the energies of the rotational levels of a generalized, spheroidally deformed nucleus was developed using a simple nuclear model, and the general effect of this interaction on rotational bands is discussed. Part of the energy level schemes of Pa^{231} and Pa^{233} were interpreted in terms of rotational bands perturbed by the Coriolis interaction. (auth)

19797 UCRL-9083

California. Univ., Berkeley. Lawrence Radiation Lab.
FISSION AND SPALLATION IN NUCLEAR REACTIONS INDUCED BY HEAVY IONS (thesis). Glen E. Gordon. May 1960. 152p. Contract W-7405-eng-48. OTS.

Several features of fission and spallation reactions proceeding through astatine compound nuclei formed by carbon-ion and nitrogen-ion bombardment were investigated. The kinetic-energy spectra of the fission fragments were observed at various angles to the beam over a range of bombarding energies by use of two types of detectors, gas scintillation chambers and diffused p-n junctions. Cross sections for neutron-evaporation reactions were determined by radiochemical measurement of the production of astatine isotopes. Analysis of the fission-fragment

angular distributions according to the models by Halpern and Strutinski and by Griffin, together with the dependence of the fission and spallation cross sections on bombarding energy, suggested that fission was frequently preceded by evaporation of neutrons and charged particles. This result was explained on the basis of increasing probability for charged-particle emission with excitation energy and hindrance of neutron evaporation at low energies due to angular-momentum and level-density effects. The latter argument was also used to explain discrepancies between experimental and theoretical shapes of the excitation functions for neutron-evaporation reactions. Evidence was also found that, in the astatine region, a larger total kinetic energy release was associated with symmetric fission than with the asymmetric modes. This was a reversal of the trend found in heavier elements. In order to obtain the data presented in the main body of the thesis, several supplementary investigations were necessary. These are discussed in the appendices. (auth)

19798 UCRL-9229

California. Univ., Berkeley. Lawrence Radiation Lab. HINDRANCE FACTORS FOR ALPHA DECAY. Helen V. Michel. May 1960. 26p. Contract W-7405-eng-48. OTS.

Half lives for alpha emission were calculated for nearly all of the complex alpha spectra. The spin-independent ($l = 0$) equations of Preston were employed. Where possible, experimental data are compared to the calculated values. (C.J.G.)

19799 WADD-TR-60-217

Texas Nuclear Corp., Austin, Tex. ELASTIC AND INELASTIC SCATTERING OF 4.1 MEV NEUTRONS FROM Ca, Mo, Sb, Ba, AND Hg. Period covered: March 15, 1959–February 18, 1960. Lloyd D. Vincent, Ira D. Morgan, and J. T. Prud'homme. Apr. 1960. 63p. Project 2134. Contract AF33(616)-5619, Supplemental Agreement No. S2(59-1242). OTS.

An investigation of the interaction of 4.1-Mev neutrons with Ca, Mo, Sb, Ba, and Hg was performed. The following determinations were made: (a) the angular distribution of the elastically scattered neutrons from Ca, Mo, Sb, Ba, and Hg; (b) the angular distribution of the inelastically scattered neutrons for Mo, Sb, Ba, and Hg; (c) energy distributions at 90° for Ca, Mo, Sb, Ba, and Hg; (d) nuclear temperatures for the residual nucleus of Mo, Sb, Ba, and Hg; and (e) total, elastic, and non-elastic cross sections for Ca, Mo, Sb, Ba, and Hg. (auth)

19800

STUDY OF THE FISSION OF U^{235} WITH EMISSION OF A LIGHT PARTICLE. J. Catalá, V. Domingo, J. Casanova, F. Senent, and A. Lleó (Instituto de Optica "Daza de Valdes," Valencia and Universidad, Valencia). *Anales real soc. españ. fís. y quím. (Madrid)*, Ser. A 56, 19-28(1960) Jan.-Feb. (In Spanish)

More than 300 U^{235} fission events with emission of a light particle were studied, and a continuous spectrum from 30 to 450 μ with a maximum at 110 μ corresponding to 15 Mev was found. The mean emission angle between the light particle and heaviest fragment is 83° . This figure seems to be isotropic when the energy of the alpha particle is increasing. The mean ranges of the heavy fragments were found to be 10.9 and 13.8 μ , respectively; their respective masses are $M_1 = 142 \pm 13$ amu and $M_2 = 90 \pm 12$ amu. (W.L.H.)

19801

TWO CASES OF TRIPLE FISSION OF U^{235} BOMBARDED WITH SLOW NEUTRONS. J. Catalá, J. Casanova, and V. Domingo (Instituto de Optica "Daza de Valdes,"

Valencia and Universidad, Valencia). *Anales real soc. españ. fís. y quím. (Madrid)*, Ser. A 56, 29-34(1960) Jan.-Feb. (In Spanish)

Two cases of triple fission of U^{235} bombarded with slow neutrons are presented. The calculated mass values of the light particles are 12 ± 2 and 11 ± 2 mu, and their calculated energies are 166 ± 33 and 187 ± 36 Mev. (W.L.H.)

19802

MAXIMUM LIMIT OF THE LIGHT PARTICLE SPECTRUM FROM THE U^{235} FISSION BY SLOW NEUTRONS. J. Catalá, J. Casanova, V. Domingo, F. Senent, E. Villar, and R. Font (Instituto de Optica "Daza de Valdes," Valencia and Universidad, Valencia). *Anales real soc. españ. fís. y quím. (Madrid)*, Ser. A 56, 39-42(1960) Jan.-Feb. (In Spanish)

A study of the maximum limit of the light particle spectrum from U^{235} fission by slow neutrons was carried out. Four events were found and two were studied by the radius of curvature method. These two events were found to be alpha particles with an energy between 29 and 35.5 Mev. (W.L.H.)

19803

ANGLE OF ROTATIONAL TRANSFORMATION. A. Galindo Tixaire (Junta de Energia Nuclear, Madrid). *Anales real soc. españ. fís. y quím. (Madrid)*, Ser. A 56, 55-6(1960) Jan.-Feb. (In Spanish)

A method is presented for the calculation of the rotational transformation angle in any closed channel geometry. The main result is that such an angle only depends on the torsion integral along the magnetic axis. The method is applied to the stellarator. (W.L.H.)

19804

FAST-NEUTRON ABSORPTION CROSS-SECTIONS. T. S. Belanova. *Atomnaya Energ.* 8, 549(1960) June. (In Russian)

Three neutron sources (Sb-Be, Na- D_2O , and Na-Be) with mean neutron energies of 24 ± 3 , 220 ± 20 , and 830 ± 40 kev were used for measuring neutron absorption cross section for Si, S, Ti, Cr, Fe, Sr, Mo, Ag, Te, I, W, Au, Hg, Th, and U. (R.V.J.)

19805

THE DEGREE OF EQUILIBRIUM BETWEEN THE SHORT-LIVED DECAY PRODUCTS FROM ATMOSPHERIC RADON. L. S. Ruzer. *Atomnaya Energ.* 8, 557-9(1960) June. (In Russian)

A method is suggested for determining the concentration of radon short-life daughter products by measuring only the magnitude of ionization. Ionization produced only by α -emitting isotopes (RaC and RaC') is examined because in the case studied the α energies are considerably higher than the β . The graph for the function F indicates characteristic increases of the ionization in the chamber at various magnitudes η_A , η_B , and η_C . The ionization values correspond to various ratios of equilibrium η_A , η_B , and η_C over a period of 60 to 80 min. The method is simple, requires only an ordinary electrometer, and can be applied for measuring η_A , η_B , and η_C in small containers. The method can also be used for determining daughter product concentrations of various emanations. (R.V.J.)

19806

HALF-LIFE OF IRIIDIUM 192. J. W. Allison (Defence Standards Labs., Australian Defence Scientific Service, Melbourne). *Brit. J. Appl. Phys.* 11, 302-4(1960) July.

Using a null method, an ionization chamber and vibrating reed electrometer were employed to compare the γ activity of an Ir^{192} source with that of a reference Ra^{226} source

over a period of 209 days. An analysis of the results by the method of least squares indicates a half life of Ir^{192} of 74.17 ± 0.07 days. (auth)

19807

CROSS SECTIONS OF Po^{208} , Po^{206} , and Po^{210} PRODUCED DURING THE BOMBARDMENT OF Bi^{209} BY 155-Mev PROTONS. Claude Deutsch and Marc Lefort (Faculté des Sciences de Paris, Orsay, France). *Compt. rend.* **250**, 3624-5(1960) May 30. (In French)

A radiochemical study was made of the spallation reactions at 155 Mev (p,xn) on bismuth. The cross sections of Po^{206} and Po^{208} are respectively 46 and 18 mb, in agreement with the calculated values. A value of 13 b was found for Po^{210} , which was attributed to secondary reactions. For Po^{209} the upper limit of the experimental value was estimated to be 2. (tr-auth)

19808

V AND A REACTIONS BY β - γ ANGULAR CORRELATION TO THE RESONANCE IN ARSENIC-76. Maurice Spighel (Faculté des Sciences [de Paris], Orsay, France). *Compt. rend.* **250**, 3626-8(1960) May 30. (In French)

The β - γ angular correlation to the resonance with β branching at 2.41 Mev of As^{76} excludes S and T reactions and is compatible only with V and A reactions, if one considers the relative probabilities for the different angular moments taken by the leptons, given by other methods. (tr-auth)

19809

SPATIAL DISTRIBUTION OF ENERGY DISSIPATED BY FALLOUT β -RAYS. A. E. Boyd and E. E. Morris (Ottawa Univ., Kansas). *Health Phys.* **2**, 321-5(1960) May.

Calculations are described of the spatial distribution of energy dissipated in air by the delayed beta rays from products of slow neutron U^{235} fission. Results are given for both plane isotropic and point isotropic sources for times after fission of 1.12 and 23.8 hr. (auth)

19810

STATISTICS OF RADIOACTIVE ATOMIC NUCLEI TRANSFORMATION FORMING FAMILIES. R. M. Kogan (Inst. of Applied Geophysics, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz.* No. 5, 680-7(1960) May. (In Russian)

Statistical fluctuations of daughter product decay forming radioactive families are analyzed. Dispersion formulas are supplied for dispersion of any number of daughter nuclei decaying in a time range (t_1, t_2) as well as for dispersion of a combined number of decays for several daughter elements. (tr-auth)

19811

NUCLEAR MAGNETIC SHIELDING IN MOLECULES: HYDROGEN MOLECULE. S. K. Sinha and A. Mukherji (Saha Inst. of Nuclear Phys., Calcutta). *J. Chem. Phys.* **32**, 1652-6(1960) June.

A method for calculating nuclear magnetic shielding in molecules was developed using valence-bond or LCAO type molecular orbitals. The perturbation of the molecular wave function due to a steady magnetic field is derived by solving the first-order perturbation equation. The method was applied to the calculation of proton shielding in hydrogen molecule with the Wang function. The value of $\sigma^P = -0.55 \times 10^{-5}$ is in good agreement with the value of -0.56×10^{-5} derived by Ramsey from the experimental value of the spin-rotational coupling constant in hydrogen molecule. (auth)

19812

REACTIONS INITIATED BY THE β DECAY OF TRITIUM.

III. THE TRITIUM-CYCLOPROPANE SYSTEM.

Preston L. Gant and Kang Yang (Continental Oil Co., Ponca City, Okla.). *J. Chem. Phys.* **32**, 1757-63(1960) June.

The β decay of tritium in the gaseous tritium-cyclopropane system initiates reactions forming various tritiated compounds. Identified products are cyclopropane, propane, propylene, isobutane, ethane, ethylene, and acetylene. Dependence of the labeling yields on T_2 concentration clearly showed that energetic electrons as well as the decay species $(\text{He}^3\text{T})^+$ initiated the labeling processes. Ionic and/or hot-atom reactions are assumed to occur to explain the effects of nitric oxide and temperature on the labeling yields. (auth)

19813

RADIOACTIVE DECAY PROPERTIES OF ^{238}Am , ^{239}Am , ^{240}Am , ^{240}Cm , AND ^{241}Cm . R. A. Glass, R. J. Carr, and W. M. Gibson (Univ. of California, Berkeley). *J. Inorg. & Nuclear Chem.* **13**, 181-91(1960) May.

Some electron-capture and α -decay properties of neutron-deficient americium and curium isotopes were investigated using 2π proportional counting, scintillation spectrometry, and α -pulse analysis. The results for Am^{238} include a new half life of 1.86 hr and identification of γ rays of ~370 keV (~12%), 580 keV (~29%), ~950 keV (~2%), 980 keV (~76%), and ~1350 keV (~17%). The data on Am^{239} (half life 12.1 hr) indicate γ rays of 225 keV (~30%) and 275 keV (~20%) with a new α -particle energy of 5.77 MeV and abundance of $5.0 \times 10^{-3}\%$. For Am^{240} (half life 51.0 hr) γ rays of 900 keV (~23%) and 1000 keV (~77%) and a negatron branching limit of $\leq 6 \times 10^{-6}\%$ were established. For Cm^{240} a new α -particle energy of 6.26 MeV was established. For Cm^{241} a new alpha particle energy of 5.95 MeV and abundance of 0.96% and a γ ray of 478 keV (97%) were established. Counting efficiencies for the 2π -geometry methane-flow proportional counter are 60, 90, and 82% for the electron-capture decay of Am^{239} , Am^{240} , and Cm^{241} , respectively. These are in the range of values found for other β -unstable isotopes of heavy elements. The data on Am^{238} and Am^{240} are consistent with a rule that only levels ~1000 keV and higher in even-even plutonium isotopes are populated by relatively fast β transitions (log ft 5 to 8) in the decay of odd-odd americium and neptunium isotopes. (auth)

19814

THE DETERMINATION OF THE PARTIAL α - AND β -HALF-LIVES OF ^{241}Pu . F. Brown, G. G. George, D. E. Green, and D. E. Watt (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). *J. Inorg. & Nuclear Chem.* **13**, 192-5(1960) May.

Measurements of α -spectra and α -emission rates from an electromagnetically separated sample of plutonium containing 77% Pu^{241} gave a value of 13.24 ± 0.24 years for the β -half-life of this isotope and a new value of $5.72 \pm 0.1 \times 10^5$ years for the α -half-life resulting in an α/β branching ratio of $2.31 \pm 0.06 \times 10^{-5}$. (auth)

19815

NEW ISOMERS OF SCANDIUM-50 AND INDIUM-120; γ -RAYS IN LUTECIUM-178 DECAY. A. Poularikas, J. Cunningham, W. McMillan, J. McMillan, and R. W. Fink (Univ. of Arkansas, Fayetteville). *J. Inorg. & Nuclear Chem.* **13**, 196-9(1960) May.

In the course of a systematic study of fast neutron activation cross-sections utilizing the Arkansas 400 kv Cockcroft-Walton accelerator, several new radioactive species were identified and γ rays assigned in the decay of others. Several unidentified new radioactivities were observed, but not studied further. A summary is given of all available new information on these activities. (auth)

19816

RARE MODES IN THE SPONTANEOUS FISSION OF CALIFORNIUM-252. E. W. Titterton and T. A. Brinkley (Australian National Univ., Canberra). *Nature* **187**, 228-9 (1960) July 16.

Californium-252 is a man-made transuranic element which has an alpha particle half life of 2.5 years and which undergoes spontaneous fission. Results are reported from an investigation of the possibility of rare modes of spontaneous fission. Minute traces of californium-252 were incorporated into Ilford K₀ and E₁ emulsions and an analysis made of 40,000 binary events in these emulsions. Ternary fission and events believed to be true spontaneous quaternary fission were observed. (C.H.)

19817

LIFETIME MEASUREMENTS ON THE FIRST EXCITED STATES OF Mg²⁵ AND Al²⁵. A. T. G. Ferguson, M. A. Grace, and J. O. Newton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Phys.* **17**, 1-8 (1960) June (2). (In English)

The lifetimes of the first excited states of the nuclei Mg²⁵ and Al²⁵ were measured using both γ - γ coincidences and pulsed beam methods. The values obtained are $\tau_{\frac{1}{2}}(\text{Mg}^{25}) = 3.5 \pm 0.2 \times 10^{-9}$ sec and $\tau_{\frac{1}{2}}(\text{Al}^{25}) = 1.8 \pm 0.3 \times 10^{-9}$ sec. The difference between the reduced transition probabilities for these two which amounts to a factor of 10 is attributed to the fact that one is an odd proton and the other an odd neutron transition. (auth)

19818

THE DECAY OF THE 136 kev LEVEL IN Fe⁵⁷. A. T. G. Ferguson, M. A. Grace, and J. O. Newton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Phys.* **17**, 9-15(1960) June (2). (In English)

Coulomb excitation of the 136 kev state in Fe⁵⁷ was made using 2 Mev helium ions and a number of its properties were studied. The angular distributions of the γ rays from this state were measured. Considerable perturbation of the state is required to explain these results. For the intensity of the 122 kev γ ray relative to that of the 136 kev γ ray a value of 8.6 ± 0.2 was obtained. The half life of the state was measured and found to be $8.6 \pm 0.8 \times 10^{-9}$ sec. A measurement of the Coulomb excitation cross section leads to a value for the upward B(E2) of $0.043 \pm 0.005 \times 10^{-48}$ e²cm⁴. This is consistent with the lifetime result if the spin of the 136 kev level is assumed to be $\frac{5}{2}$. (auth)

19819

MATRIX ELEMENTS IN NUCLEAR SHELL THEORY. T. A. Brody, G. Jacob, and M. Moshinsky (Universidad, Mexico). *Nuclear Phys.* **17**, 16-29(1960) June (2). (In English)

Transformation brackets for harmonic oscillator functions have been defined and used for the evaluation of matrix elements for nuclear forces. Numerical tables for the transformation brackets are now available. These tables are used to evaluate the matrix elements of nuclear shell theory directly in terms of Talmi integrals. For comparison between present methods and those used previously, a relation between Slater coefficients and Talmi integrals is also obtained. (auth)

19820

THE EXCHANGE TRANSFER REACTION Al²⁷(N¹⁴, Mg²⁷)O¹⁴. J. J. Pinajian (Oak Ridge National Lab., Tenn.). *Nuclear Phys.* **17**, 44-53(1960) June (2). (In English)

The thick target yield was measured for the reaction Al²⁷(N¹⁴, Mg²⁷)O¹⁴, which may be described as a simultaneous transfer of a neutron from one nucleus and a proton

from the other. Mg²⁷ was chemically separated and thick target yields were measured by absolute γ -counting. A second aluminum foil behind the target was used to determine the amount of Mg²⁷ produced by neutrons in the target. The ratio of front to back foil Mg²⁷ yield was 1.54:1.00. Thick targets of ZnO were used to measure the yield of O¹⁶(N¹⁴, 3p)Mg²⁷. The cross section at 27.6 Mev was found to be 110 μ b. The yield of Mg²⁷ in the 10 Å oxide layer of the special aluminum foil targets was estimated to be 1.5% of the total yield. The thick target yield of 9.45-min Mg²⁷, in aluminum, measured at 27.6 Mev incident energy, was found to be 13.6×10^{-12} per incident nitrogen ion after correction for neutron-induced Mg²⁷. The cross section is estimated to be 2.2 ± 1.0 μ b. Mg²⁷ cannot be produced by the evaporation of light particles as in Al²⁷(N¹⁴, 3 α 2p)Mg²⁷. Other possible mechanisms for the production of Mg²⁷ are examined and their cross sections are estimated. (auth)

19821

THE FISSION OF GOLD BY OXYGEN NUCLEI. A. R. Quinton, H. C. Britt, W. J. Knox, and C. E. Anderson (Yale Univ., New Haven). *Nuclear Phys.* **17**, 74-88(1960) June (2). (In English)

The angular distribution and the energies of the fission fragments, emitted in the bombardment of a thin gold foil by 160 Mev oxygen nuclei, were experimentally determined by the use of a proportional counter detector. By a comparison with the theory of Halpern and Strutinski an estimate has been made of the shape of the fissioning nucleus at the saddle point. The total kinetic energy released was determined to be 150 Mev. It is claimed that the fissioning nucleus has typically a mass of 204 mass units. The possibility of the emission of charged particles, as well as neutrons, in some of the evaporation chains preceding fission, is discussed. A fission cross section of 1.8 ± 0.2 b was obtained. (auth)

19822

NOTE ON THE SPIN-ORBIT PART OF THE OPTICAL MODEL POTENTIAL. J. Sawicki (Univ. of California, Berkeley). *Nuclear Phys.* **17**, 89-95(1960) June (2). (In English)

The spin-orbit part of the optical model potential is calculated using a modified, more accurate form of the impulse approximation model of Riesenfeld and Watson. In contrast to the usual model, integrations over the target particle momentum are performed. Comparison with the usual theories is discussed and the polarization of nucleons elastically scattered from carbon nuclei is derived with the use of the Signell-Marshak nucleon-nucleon scattering phase shifts. (auth)

19823

A MODEL FOR THE INTERPRETATION OF K⁻-MESON CAPTURES AT REST IN COMPLEX NUCLEI. I. E. McCarthy and D. J. Prowse (Univ. of California, Los Angeles). *Nuclear Phys.* **17**, 96-108(1960) June (2). (In English)

A model for the interactions of K⁻-mesons in complex nuclei is proposed which combines the peripheral absorption ideas of Jones and to a limited extent the idea of volume absorption proposed by Gilbert, Violet, and White. The model is capable of explaining the observed experimental effects without demanding momentum correlations in the nucleus and without the necessity of invoking the idea of nuclear surface clusters first proposed by Wilkinson. The energy spectra of both the Σ^{+} - and Σ^{-} -hyperons resulting from the single nucleon reactions in emulsion nuclei in which both pion and Σ -hyperon are observed to emerge from the interaction, are well fitted assuming that these

reactions mainly occur at the nuclear surface. The energy spectrum of Σ -hyperons (>60 Mev) unaccompanied by π -mesons which are assumed to result from the multi-nucleon reaction of the type $K^- + p + p \rightarrow \Sigma^+ + n$ and similar reactions, is consistent with the assumption that the nucleons involved are uncorrelated in momentum space. The relative cross sections for the two processes are also consistent with this assumption, hence the nucleon cluster interpretation of these events is open to doubt. (auth)

19824

TOTAL NEUTRON CROSS SECTION OF B^{10} IN THE THERMAL NEUTRON ENERGY RANGE. H. W. Schmitt, R. C. Block, and R. L. Bailey (Oak Ridge National Lab., Tenn.). *Nuclear Phys.* **17**, 109-15(1960) June (2). (In English)

A precise determination of the total neutron cross section of B^{10} was made by means of transmission measurements of boron samples highly enriched in B^{10} . The ORNL fast chopper time-of-flight spectrometer was used to obtain results in the neutron energy range 0.018 to 0.4 eV. It is found that the total cross section of B^{10} in this energy range follows the relation $\sigma_t(b) = (612 \pm 6)/\sqrt{E(eV)}$. The total cross section of B^{10} for neutrons of energy 0.0253 eV (velocity = 2200 m/sec) is found to be 3848 ± 38 b. (auth)

19825

A STUDY OF ENERGY LEVELS IN Sc^{43} , Ti^{45} , V^{47} , V^{49} , V^{50} AND Zn^{65} . G. J. McCallum, A. T. G. Ferguson, and G. S. Mani (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Phys.* **17**, 116-28(1960) June (2). (In English)

Thresholds for neutron emission following the proton bombardment of Ca^{43} , Ca^{44} , Sc^{45} , Ti^{47} , Ti^{49} , Ti^{50} , and Cu^{65} were studied up to a proton energy of 4.9 Mev. The positions of excited states in Sc^{43} , Ti^{45} , V^{47} , V^{49} , V^{50} , and Zn^{65} were determined. (auth)

19826

LOCATION OF THE $3s_{1/2}$ SINGLE PARTICLE NEUTRON LEVEL IN VARIOUS NUCLEI. Bernard L. Cohen and Robert E. Price (Univ. of Pittsburgh). *Nuclear Phys.* **17**, 129-40(1960) June (2). (In English)

The $3s_{1/2}$ neutron levels in nuclei of mass 85 to 135 are located by angular distributions of protons from (d, p) reactions on nuclei with even neutron numbers. Where the proton number is even, almost all of the single particle level is in one nuclear level, and where there is an odd proton of low j , it is in two levels with spin $j + 1/2$ and $j - 1/2$ which are separated by about 60 keV. Both of these cases are in agreement with the simple single particle model with negligible configuration mixing, but where there is an odd proton of large j , the single particle level has many components, indicating strong configuration mixing. The binding energy of the $3s_{1/2}$ neutron varies very smoothly from isotope to isotope of the same element, and when corrected for symmetry energy, its variation with A is very smooth. The variation with A decreases about by half when its major shell begins filling, and becomes negligible when ground states of odd-mass nuclei are $s_{1/2}$. This is explained as due to the fact that the levels become partially "hole" states, and since the energy of particle and hole states shift in opposite directions as a function of mass number, the two effects tend to cancel. Since, according to pairing theory and experimental observations, all subshells in a major shell begin to fill when the major shell begins to fill, energy shifting of a single particle level decreases rapidly once its major shell begins to fill. The observed shifting is in at least semi-quantitative agreement with the theory. Some difficulties with the Wilkinson theory of the photonuclear

giant resonance are pointed out, and strong evidence against reduced mass effects in excited states of nuclei are presented. (auth)

19827

MEASUREMENT OF ELASTIC SCATTERING OF 28-Mev ELECTRONS BY HEAVY NUCLEI. J. B. Bellicard and P. Barreau (Centre d'Etudes Nucleaires, Saclay, France). *Nuclear Phys.* **17**, 141-52(1960) June (2). (In French)

Measurements were made on 28 MeV electron scattering by gold-197 and bismuth-209 nuclei. Angular distributions of scattered electrons gave the root mean square radius of the charge distribution of the two nuclei with a precision of two per cent. For the parameter r_0 entering into the expression for the radius $R = r_0 A^{1/3}$ of the homogeneous sphere adopted as charge distribution model, $r_0 = 1.17 \pm 0.02 \times 10^{-13}$ cm for gold, $r_0 = 1.15 \pm 0.03 \times 10^{-13}$ cm for bismuth. These results are in agreement with high-energy electron scattering results. (auth)

19828

PRODUCTION OF SHORT-LIVED ISOMERS BY PULSE ACTIVATION WITH THERMAL NEUTRONS. K. F. Alexander and V. Bredel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). *Nuclear Phys.* **17**, 153-62(1960) June (2). (In German)

An external neutron beam from the Rossendorf Research Reactor was periodically interrupted by a steel rotor. By placing a sample in the modulated neutron beam it was possible to observe short-lived isomeric states produced by thermal neutron capture. The spectra of the delayed γ radiation were measured with a scintillation spectrometer. In this way a number of isomeric transitions were found and their half-lives were obtained by means of a 5-channel time analyser. The energies and half-lives of the following isomers were measured: Na^{24m} (475 ± 10 keV, 20 ± 1 msec); Ga^m (99 ± 5 keV, 38 ± 2 msec); In^{116m} (160 ± 8 keV, 2460 ± 80 msec); Ho^{166m} (131 ± 5 keV, 0.214 ± 0.010 msec). The newly discovered Ho^{166m} has a K-conversion coefficient of about 0.4; therefore, the transition is probably of the type E2. (auth)

19829

ROTATIONAL ENERGIES AND MOMENTS OF INERTIA OF NON-AXIAL NUCLEI. A. S. Davydov, N. S. Rabotnov, and A. A. Chaban (Moscow State Univ.). *Nuclear Phys.* **17**, 169-74(1960) June (2). (In English)

It is shown that the ratios of rotational energies of a non-axial nucleus depending on the ratios of energies of two rotational states with spin 2 change but little with the deviation of nuclear moments of inertia from their hydrodynamic values. (auth)

19830

CROSS SECTION FOR $^{31}P(n,p)^{31}Si$ REACTION UP TO 5 MeV. P. Cuzzocrea, G. Pappalardo, and R. Ricamo (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). *Nuovo cimento* (10) **16**, 450-6(1960) May 1. (In English)

The cross section for the reaction $P^{31}(n,p)Si^{31}$ was measured by the activation method. The average behavior of the cross section is the same as found by others, but the new measurements show many details and a wide but well-defined peak at 3.72 MeV. Resonance peaks were observed at 2.84 and 3.13 MeV, found before by R. Ricamo. There is also evidence of other resonances around 4.5 MeV. (auth)

19831

ON THE RENORMALIZATION OF THE AXIAL VECTOR

COUPLING CONSTANT IN β -DECAY. J. Bernstein (Faculté des Sciences, Orsay, France), M. Gell-Mann (Collège de France, Paris and Ecole Normale Supérieure, Paris), and L. Michel (Faculté des Sciences, Paris and Service de Physique Théorique, Orsay, France). *Nuovo cimento* (10) 16, 560-8(1960) May 1. (In English)

The models of the axial vector current discussed by Gell-Mann and Lévy are examined further. Generalized Ward identities are derived for the axial vector weak vertex. It is then shown that in the σ model and the non-linear model the renormalization factor $-G_A/G$ may be expressed as a matrix element in the theory of strong interactions. Thus in the σ model, which is renormalizable, $-G_A/G$ is finite in every order. Since $-G_A/G$ exhibits divergences in the non-linear model, that model is not renormalizable in the usual sense. (auth)

19832

ON THE ELECTROMAGNETIC FEATURES OF SPACE IN NUCLEAR AND ATOMIC FIELDS. Ugo Tiberio (Centro di studio per l'elettronica e le Telecomunicazioni, Pisa, Italy). *Ricerca sci.* 30, 553-60(1960) Apr. (In Italian)

Based on values of ϵ and μ of empty space, according to Einstein-Schwarzschild transformation, an attempt is made to calculate the electromagnetic radius of the nucleus of heavy elements and of the atom. To this end, certain features are attributed to the mass nuclear field and to the atom centripetal field, which are analogous from the relativistic point of view to those of the gravitational field. The results of this calculation do not seem to be in conflict with the experimental values. Other deductions concerning nuclear spaces in connection with the dimensions of the elementary charge, e.g., the non-existence of elementary separated magnetic mass, the velocity of electromagnetic perturbations, and the mass excess, are not in conflict with the nuclear patterns which are most frequently adopted. The advisability of carrying out further researches concerning the limits and the relations between general classical relativity and modern physics is pointed out. (auth)

19833

YIELD OF PHOTONEUTRONS EMITTED FROM LEAD UNDER THE ACTION OF 10.5-20.5 MEV ELECTRONS. V. M. Grizhko, D. I. Sikora, V. A. Shkoda-Ul'yanov, A. D. Abramnikov, B. I. Shramenko, and A. N. Fisun (Uzgorod State Univ., Ukrainian, SSR). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1370-3(1960) May. (In Russian)

The yield of photoneutrons from a thick lead plate on total absorption of a monochromatic electron beam was measured. The experimental curve is compared with the theoretical curves computed with the aid of the Belenky-Tamm equilibrium spectra. Absolute energy calibration of the monochromator was based on the threshold of the (γ, n) -reaction in oxygen and carbon. (auth)

19834

KINETIC ENERGY OF THE FRAGMENTS OF PHOTOFISSION OF U^{238} . B. A. Bozhagov, A. P. Komar, and G. E. Solyakin (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1374-80(1960) May. (In Russian)

A double chamber was employed to study the energy distribution of U^{238} photofission fragments. Gamma rays with $E_{\gamma, \max} = 70$ Mev were obtained from a synchrotron. A contour diagram of the kinetic energy distribution of the fragments was plotted. The contour diagram for photofission of U^{238} is compared with diagrams obtained for the fission of heavy elements induced by neutrons of various energy. (auth)

19835

INVESTIGATION OF THE MAIN X-RAY K-ABSORPTION EDGE IN SELENIUM. D. Bally and L. Müller (Inst. of Nuclear Physics, Bucharest). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1381-2(1960) May. (In Russian)

The position and width of the main x-ray K-absorption edge are measured for crystalline and amorphous selenium. The dependence of the structure of the main edge on thickness of the absorber is investigated. (auth)

19836

NUCLEAR DISINTEGRATIONS IN A PHOTOGRAPHIC EMULSION PRODUCED BY 930 MEV PROTONS. O. V. Lozhkin, N. A. Perfilov, A. A. Rimskii-Korsakov, and Dzh. Fremlin (Radium Inst., Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1388-98(1960) May. (In Russian)

Interactions between 930 Mev protons and photographic emulsion nuclei were investigated, special attention being directed to interactions involving the emission of multi-charged particles with $Z \geq 3$. The relative yields of hydrogen, helium, and lithium nuclei, and nuclei with $Z \geq 4$ were determined for light and heavy nuclei disintegrations with ≥ 3 prongs. For Ag and Br disintegrations the cross section for lithium isotope production was found to equal (135 ± 31) mb and the cross section for production of fragments with $Z \geq 4$ was found to equal (62 ± 11) mb. Angular and energy distributions of the fragments, multiplicity of fragment production, dependence of the probability of fragment production on the number of α -particles and protons in the disintegration, and other fragmentation characteristics were determined. The fragmentation mechanism is discussed. (auth)

19837

ANGULAR DISTRIBUTIONS OF 6.8 MEV PROTONS ELASTICALLY SCATTERED ON CHROMIUM, NICKEL, AND COPPER ISOTOPES. A. K. Val'ter, I. I. Zalyubovskii, A. P. Klyucharev, M. V. Pasechnik, N. N. Pucherov, and V. I. Chirko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian, SSR). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1419-23(1960) May. (In Russian)

The angular distributions of 6.8 Mev protons elastically scattered on $Cr^{52,53}$, $Ni^{58,60,62}$, and $Cu^{63,65}$ isotopes were investigated. Appreciable differences in the variation of the differential cross sections were found in the various isotopes. The results indicate that in scattering studies, individual features of the nuclei should be taken into account. (auth)

19838

ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS. G. N. Lovchikova. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1434-5(1960) May. (In Russian)

Differential cross sections for elastic scattering of neutrons from $Na^{24}(\gamma, n)$ on Pb, Bi, Fe, Sn, and Al nuclei were measured at 30 to 150°. Values of the total elastic cross section, transport cross section, and the mean value of the cosine of the scattering angle are derived from the measured angular distributions. (auth)

19839

INVESTIGATION OF α -DECAY OF U^{238} . A. P. Komar, G. A. Korolev, and G. E. Kocharov (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1436-8(1960) May. (In Russian)

An ionization chamber with a grid was employed to investigate the α spectrum of U^{238} . After introduction of corrections to account for ionization, imperfect grid shielding, and rise time of the pulse, the energy of the

fundamental α group was found to be (4.488 ± 0.003) Mev. The energies and intensities of transitions to the 2^+ and 4^+ levels of the daughter nucleus were also determined. (auth)

19840

DETERMINATION OF THE SPINS OF Pt^{196} NUCLEAR LEVELS ON BASIS OF γ -RAYS EMITTED IN THE CAPTURE OF RESONANCE NEUTRONS. N. D. Galanina, B. F. Shvartsman, and A. Ya. Diamant. Zhur. Eksptl'. i Teoret. Fiz. **38**, 1446-50(1960) May. (In Russian)

Gamma rays produced in the capture of resonance neutrons are investigated. From the presence of the ground transition in the γ spectrum, the spin of the compound nucleus levels is determined. It is found for the Pt^{196} nucleus that the spin is 1 for levels with neutron energies of 11.9 and 68.2 ev and 0 for a level energy of 19.6 ev. (auth)

19841

INFLUENCE OF COULOMB ATTRACTION ON THE CROSS SECTION FOR ABSORPTION OF ANTIPROTONS BY NUCLEI. P. E. Nemirovskiy and Yu. D. Fivelskiy. Zhur. Eksptl'. i Teoret. Fiz. **38**, 1486-8(1960) May. (In Russian)

The influence of Coulomb attraction on the cross section for absorption of antiprotons whose energy is small compared with the Coulomb energy at the nuclear boundary is investigated. Interaction between the antiprotons and nuclei is treated on the basis of the optical model. Calculations are presented for C, Cu, and Pb nuclei for nuclear attraction as well as repulsion potentials. It is shown that due to Coulomb attraction the cross section for antiproton absorption at energies below the Coulomb energy is 4 to 10 times greater than the cross section for antineutrons of the same energy. (auth)

19842

RELATIVISTICALLY COVARIANT SPIN STRUCTURE OF THE S-MATRIX. V. I. Ritus (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1489-98(1960) May. (In Russian)

Relativistically covariant spin structure of the S-matrix is considered for the reactions $a + b \rightarrow a' + b'$, $\gamma + b \rightarrow a' + b'$, $\gamma + b \rightarrow \gamma' + b'$, and $a + b \rightarrow 2\gamma$. The S-matrix is represented in a form in which the separate terms correspond to transitions between states with definite initial and final spins of the system. (auth)

19843

ON TRANSITIONS BETWEEN HYPERFINE STRUCTURE LEVELS IN μ -MESIC ATOMS. A. E. Ignatenko (Joint Inst. for Nuclear Research, [Dubna, USSR]). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1515-17(1960) May. (In Russian)

The possibility of an experimental verification of the existence of transitions between hyperfine structure levels in mesic atoms is considered. It is shown that in the case of mesic atoms possessing nuclear spins $J > 1/2$, measurement of the precession frequency of the mesic atoms should be a convenient method. (auth)

19844

POLARIZATION OF β -ELECTRONS FROM ORIENTED RaE. A. Z. Dolginov and N. P. Popov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1518-24(1960) May. (In Russian)

A formula is deduced for the polarization vector of electrons emitted in β -decay of a RaE nucleus whose spin is oriented in an external field. The region of possible nuclear matrix element values is determined on the basis of experimental data referring to the shape of the spectrum and longitudinal polarization of the β particles.

These values are used to compute the polarization of β particles from oriented RaE. The dependence of polarization on the assumed nuclear radius is considered. It is shown that transverse polarization of β particles is very sensitive to any possible nonconservation of time parity. (auth)

19845

POLARIZATION OF A HYDROGEN ATOM IN THE GROUND STATE BY THE FIELD OF A POINT CHARGE. V. P. Shmelev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1528-33(1960) May. (In Russian)

The dipole moment, p , of a hydrogen atom in the ground state, induced by a positive charge e is considered as a function of the distance between the charge and atomic nucleus. The proton and the hydrogen atom in this state does not form a stable system. The stability of a proton-electron-positron quasimolecule is investigated with aid of the solution thus obtained. (auth)

19846

HEAVY ION EXCITATION OF NUCLEI ACCOMPANIED BY RADIATION OF γ -QUANTA. B. N. Kalinkin (Joint Inst. for Nuclear Research, [Dubna, USSR]). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1541-3(1960) May. (In Russian)

Coulomb excitation of high single-nucleon levels in the nucleus due to bombardment with heavy ions possessing energies smaller than that of the Coulomb barrier is considered. The magnitudes of the cross sections thus obtained indicate that an experimental proof of the existence of such levels may be feasible. (auth)

19847

FORM FACTOR AND THE μ -CAPTURE ON LIGHT NUCLEI WITH SPIN $1/2$. Tso-hsiu Ho (Joint Inst. for Nuclear Research, [Dubna, USSR]). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1620-6(1960) May. (In Russian)

Various processes of μ -capture on light nuclei with spin $1/2$ without emission of neutrons or protons are studied. Calculations show that the form factor gives significant correction to these processes. (auth)

19848

COLLECTIVE EXCITATION OF NONAXIAL EVEN-EVEN NUCLEI. A. A. Chaban (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1630-6(1960) May. (In Russian)

Collective excitation states of nonaxial even-even nuclei are investigated with account of interaction between rotational and vibrational states. (auth)

19849

SUPER-HEAVY ISOTOPES OF HYDROGEN AND HELIUM. V. I. Gol'danskii (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1637-9(1960) May. (In Russian)

Data on neutron pairing energy were applied for estimating the stability of H^5 , H^7 , and He^8 isotopes. The pairing energies E_{pair} (the bond energy difference of $2m + 2nd$ and $2m + 1st$ neutrons in the first six neutron layers from $1s_{1/2}$ to $2s_{1/2}$) are plotted for elements from hydrogen to potassium. It was observed that the pairing of nuclei with odd proton numbers is always weaker due to the breakup of deuteron-like triplet pn-bonds in odd-odd nucleus coupling. In $p_{1/2}$ shells saturated in H^4 to He^8 , the pairing of third and fourth neutrons produces less energy (64 to 90%) than the first neutron pair. The above data are correlated for estimating the pairing energy and stability of super-heavy isotopes. (R.V.J.)

19850

THEORY OF RESONANCE INTERACTIONS OF γ QUANTA

IN CRYSTALS. M. V. Kazarnovskii (Lebedev Inst. of Physics, Moscow). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1652-4(1960) May. (In Russian)

The probability of elastic (without variation of the crystalline lattice quantum state) resonance interaction of γ quanta with nuclei was previously shown to contain the multiplier $f = \exp[g_{\infty}(t)]$. Considering that f is the function $g_{\infty}(T)$, the exponential evaluation of g_{∞} in Debye approximation is not always satisfactory and can be more accurately evaluated with experimental data on thermal capacity at constant volume. Data calculated on the basis of thermal capacity for Ir^{191} , $E = 129$ kev, and for Zn^{67} , $E = 93$ kev, show $g_{\infty}(0)$ is -2.75 and -5.6 , respectively. Experiments with Ir^{191} resonance γ interactions show that $g_{\infty}(0)$ is -3.0 ± 0.3 . (R.V.J.)

19851

NEW ISOTOPE Te^{115} . I. P. Selinov, N. A. Vartanov, D. E. Khulelidze, Yu. A. Blidze, N. G. Zaitseva, and V. A. Khalkin. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1654(1960) May. (In Russian)

The new isotope Te^{115} was produced by the reaction $\text{Sn}^{112}(\alpha, n)$. A fractional separation of the parent isotope Sb^{115} ($T = 32$ min) by hydrogen sulfide precipitation showed Te^{115} with $T = 6.0 \pm 0.5$ min. (R.V.J.)

Particle Accelerators

19852 AERE-R-3286

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE 7GeV PROTON SYNCHROTRON (NIMROD). SOME DESIGN DATA FOR A DYNAMIC RIPPLE FILTER CHOKE. J. V. Smith. Apr. 1960. 26p. BIS.

A graphic method of obtaining the principal parameters for large air-gap synchrotron chokes is developed. Particular examples applicable to a dynamic ripple filtering system are calculated. (auth)

19853 AERE-R-3326

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE EFFECT OF A SECOND HARMONIC IN 4-RIDGE SPIRAL CYCLOTRONS. M. Bell. Apr. 1960. 30p. BIS.

The addition of an extra harmonic in the proposed 4-ridge Harwell cyclotron conversion is shown to lower the frequency of the radial betatron oscillations. This enables a higher energy to be attained before reaching a troublesome resonance. The purely radial motion is improved, but the coupled motion achieved was not entirely satisfactory. (auth)

19854 CERN-60-17

European Organization for Nuclear Research, Geneva. Synchrocyclotron Div.

ABSOLUTE INTENSITY MEASUREMENTS ON THE EXTERNAL PROTON BEAM OF THE CERN SYNCHROCYCLOTRON—A MEASUREMENT OF THE CROSS-SECTION OF THE REACTION $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ AT 591 MEV INCIDENT PROTON ENERGY. D. Harting, J. C. Kluyver, and A. Kusumegi. Apr. 21, 1960. 26p.

The methods and apparatus are described with which the intensity of the 591-Mev external proton beam of the CERN synchrocyclotron can be measured to a relative accuracy of 1% and an absolute accuracy of 3% at any value of the beam flux. Using this intensity calibration, the absolute cross-section of the reaction $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$

was determined, and a value of 29.9 ± 1.6 mb was obtained for an incident proton energy of 591 Mev. (auth)

19855 CERN-60-23

European Organization for Nuclear Research, Geneva. CERN PROTON SYNCHROTRON MACHINE GROUP OPERATION AND DEVELOPMENT QUARTERLY REPORT NO. 1 [FOR THE PERIOD] JANUARY—MARCH 1960. May 15, 1960. 26p.

An experimental run was carried out in which bubble chambers containing either liquid hydrogen or freon were operated in a 16 BeV/c momentum π^- beam. Photographs taken during this operation are being analyzed. The highest beam intensity reached during the quarter was 10^{11} protons/pulse using a buncher before the linac. The normal operating intensity is about 3×10^{10} protons/pulse. The maximum energy obtainable is about 28 BeV (one pulse every 5 seconds), while the normal operating energy is about 25 BeV (one pulse every 3 seconds). Information on the machine status and operation statistics is included. A summary of individual experiments is also given. (J.R.D.)

19856 CERN-60-24

European Organization for Nuclear Research, Geneva. PHASE SPACE ANALOGUE COMPUTER FOR BEAM MATCHING PROBLEMS. B. W. Montague. May 25, 1960. 24p.

An electronic analog computer built for the solution of problems connected with the injection of the 50-Mev beam into the CERN Proton Synchrotron is described. The apparatus consists of a sequence of voltage adding networks and buffer amplifiers which simulates the continued multiplication of 2×2 matrices with unity determinant. The electronics design is described, and a section devoted to operation is included. (J.R.D.)

19857 INSJ-27

Tokyo Univ. Inst. for Nuclear Study.

THE VACUUM SYSTEM OF INS 1 BeV ELECTRON SYNCHROTRON. G. Horikoshi, H. Kumagai, S. Yamaguchi, and T. Kakuyama. Mar. 14, 1960. 10p. (TH-36).

The selection, design, characteristics, arrangement, and operation of the oil diffusion pumps for the electron synchrotron vacuum system are discussed. (W.D.M.)

19858 INSJ-28

Tokyo Univ. Inst. for Nuclear Study.

POLE PIECES OF INS 1-BeV ELECTRON SYNCHROTRON. R. Yamada and Y. Kobayashi. Mar. 21, 1960. 29p. (TH-37).

The properties of six types of pole pieces for the magnet of the 1-Bev electron synchrotron are described, including their shapes and n -values. The field measurements were done mainly with a d-c method. The high and low field characteristics are discussed. A method of calculating the influence of shims is developed and compared with experimental results. The method was successfully applied for the design of pole pieces. (auth)

19859 NP-8746

Gt. Brit. National Inst. for Research in Nuclear Science.

Rutherford High Energy Lab., Harwell, Berks, England. SECOND ANNUAL REPORT FOR THE PERIOD 1st APRIL, 1958 TO 31st MARCH, 1959. 26p.

An annual report on the organization and activities of the Rutherford High Energy Laboratory is presented. The Nimrod, a 7-Bev proton synchrotron, is discussed relative to operation, principle parameters, and the containment buildings. Descriptions of the injector, magnet, radiofrequency accelerating system, vacuum chamber, and power supplies of the Nimrod are contained. A brief description is given of a 50-Mev proton linear accelerator. (C.J.G.)

19860

A RING TYPE ACCELERATOR WITH A VERTICALLY INCREASING MAGNETIC FIELD. A. P. Fateev and B. N. Yablokov. Atomnaya Energ. 8, 552-3(1960) June. (In Russian)

Particle orbit stability in an accelerator with vertically increasing, constant in time magnetic field was investigated. The design is given of the sector and orbit distribution for a simple case where the orbit of particles is a plane curvature consisting of alternating curved and straight-line sections. The stability of a ring-type cyclotron with parameter $N = 30$, $n \approx 10$ was determined. (R.V.J.)

19861

SOME PROPERTIES OF ORBITS IN ACCELERATORS IN THE LIGHT OF SIMILARITY PRINCIPLES. A. A. Kolomenskiĭ and A. N. Lebedev. Atomnaya Energ. 8, 553-5 (1960) June. (In Russian)

The similarity principle demands the independence of characteristic betatron oscillations and accelerated particle energy. Such a condition is especially important in strong-focusing accelerators with constant fields, where the orbital parameters vary with acceleration. The condition of dynamic similarity affects the geometry of orbits and the dynamics of particle acceleration. In some cases similarity orbits are analogous to ring orbits and reflect the radiation effects in accelerators with constant fields. In turn the radiation reaction leads to positive or negative damping of betatron or synchrotron oscillations. Numerical calculations show that effective damping in an electron phasotron can be achieved with a longitudinal magnetic field which forms $\sim 10\%$ of the leading field. (R.V.J.)

19862

THE FIRST "LARGE CYCLOTRON" IN POLAND. Henryk Niewodniczański and Jerzy Zakrzewski (Inst. of Nuclear Research, Polish Academy of Sciences, Krakow). Nukleonika 5, Suppl. I, 1-24(1960). (In Polish)

The first "large cyclotron" in Poland was put into operation in the Cracow Center of Nuclear Physics, Institute for Nuclear Research, Polish Academy of Sciences. This cyclotron with polepieces of its electromagnet possessing diameters of 120 cm and accelerating deuterons to 13 Mev is used for research work in nuclear physics. The design and the operational characteristics of the cyclotron are given. (auth)

19863

ION ACCELERATION ON CYCLOTRON "SUBHARMONICS." A. P. Babichev and N. D. Fedorov. Pribery i Tekh. Ekspt. No. 1, 16-19(1960) Jan.-Feb. (In Russian)

Phase ratios in a cyclotron central region with $k = 1$ are analyzed. Ion trajectories with various starting phases φ_0 for $k = 3$ and $k = 5$ are shown, and the relative ion coordinates x/λ_1 , x/λ_5 , and x/λ_3 with various starting phases φ are plotted as functions of the angle of flight ωt for the cases of $k = 1, 3$, and 5 . Calculations adapted to nitrogen ion acceleration with the initial data $\omega_0 = 7 \times 10^7$ per second, $2\delta = 4$, $\delta = \lambda_3 = 1.65$, and $\delta/\lambda_5 = 0.81$. Strong ionic phase grouping (stronger than in the case of $k = 1$) was observed with $k = 3$ and $k = 5$. (R.V.J.)

19864

VOLTAGE STABILIZATION IN CYCLOTRON DEFLECTING SYSTEM. B. S. Kozachina, N. Z. Kubyshkin, and A. I. Nastyukha. Pribery i Tekh. Ekspt. No. 1, 110(1960) Jan.-Feb. (In Russian)

A design is given of a high-voltage stabilization scheme

with the working element, d-c amplifier grid, and cathode circuits placed underground. (R.V.J.)

19865

DISTRIBUTION OF THE OUTER BEAM CURRENT DENSITY IN CYCLOTRONS. V. M. Kirsanov, A. F. Linev, and Yu. M. Pustovolt. Pribery i Tekh. Ekspt. No. 1, 111-12 (1960) Jan.-Feb. (In Russian)

A dynamic system suggested by K. O. Nielsen et al. (Nuclear Instr. 1, No. 3, 159(1957)) is used for studying continuous variations of beam current density, degree of focusing, and beam deflection from the target center in pulsed and continuous cyclotron performance. The design of measuring device and oscillograms of the outer beam current density are included. (R.V.J.)

19866

TIME OF FLIGHT FACTOR FOR PROTON LINEAR ACCELERATOR. V. S. Kladnizkiĭ (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Tekh. Fiz. 30, 178-85 (1960) Feb. (In Russian)

An electrolytic bath was used in the investigation of the axial electric field intensity distribution along the acceleration system of a proton linear accelerator. The data were applied for determining the time of flight factor T as a function of acceleration period length L_n ; the results were correlated with calculated values. It is shown that consideration of field penetration beyond the klystron grid is important in determining T , especially with small L_n . To improve the efficiency of an acceleration system, it is necessary to obtain a ratio of period length to drift tube aperture of $L_n/d' \geq 4$. (tr-auth)

19867

ON THE THEORY OF MOVEMENT OF AN ELECTRON IN LINEAR BETATRON. Ts. I. Gutsunaev and Ya. P. Terletskii (Moscow State Univ.). Zhur. Tekh. Fiz. 30, 491-6 (1960) May. (In Russian)

A particular solution was found for relativistic electron motion in an axially symmetric, irregularly shifting, magnetic field, and the particle energy increment is derived. Problems of motion stability and accelerated electron emission are analyzed. (tr-auth)

Plasma Physics and Thermonuclear Processes

19868 AD-217641

Avco Corp. Avco-Everett Research Lab., Everett, Mass. THE LARGE HIGH PRESSURE ARC PLASMA GENERATOR: A FACILITY FOR SIMULATING MISSILE AND SATELLITE RE-ENTRY. Research Report 56. P. H. Rose, W. E. Powers, and D. Hritzay. June 1959. 32p. Contract AF04(645)-18.

Arc plasma generators incorporated into a facility for simulating missile and satellite re-entry are described. It is noted that this large source of high-pressure, high-enthalpy air, as represented by the arc plasma generators, allows test programs on ablating materials to be carried out under realistically simulated conditions. (J.R.D.)

19869 AD-228384

Avco Corp. Avco-Everett Research Lab., Everett, Mass. COLLISION FREE MAGNETOHYDRODYNAMIC SHOCK WAVE. Research Report 63. A. Kantrowitz, R. M. Patrick, and H. E. Petschek. Aug. 1959. 15p. Contracts AF49(638)-61 and Nonr-2524(00).

It is assumed that the dissipation in a collision-free

shock produces a random distribution of magnetohydrodynamic waves. These waves are then treated as the fundamental particles of the plasma. A rough kinetic theory is developed which estimates the heat conduction coefficient due to the waves. Using this heat conduction coefficient, the shock thickness is estimated to be about 4 times the characteristic ion Larmor radius. This prediction is in rough agreement with experimental results obtained in a MAST device. (auth)

19870 AD-232911

Avco Corp. Avco-Everett Research Lab., Everett, Mass. MAGNETOHYDRODYNAMIC SHOCK WAVE IN A COLLISION-FREE PLASMA. Research Report 85. F. J. Fishman, A. R. Kantrowitz, and H. E. Petschek. Jan. 1960. 29p. Contract Nonr-2524(00).

An attempt is made to identify the dissipative mechanisms operative in a shock wave with randomized magnetohydrodynamic waves of large amplitude. The entropy production process which is the scattering of waves on waves exhibited a typical "wave mean free path" which is comparable to an ion Larmor radius inside a shock front. The short mean free path determined for this scattering process implied that continuum magnetohydrodynamics can be applied in many cases when the interparticle mean free path is quite large. Using this approach, the shock thickness and its dependence on the Alfvén Mach number were determined and are in good agreement with "MAST" shock tube experiments. (C.J.G.)

19871 AD-235860

Stuttgart. Technische Hochschule. Institut für Hochtemperaturforschung.

SHOCK WAVES IN PARTLY AND FULLY IONIZED PLASMAS, WITH PARTICULAR CONSIDERATION OF THE DETERMINATION OF MEAN EFFECTIVE TEMPERATURES IN PLASMAS USING SHOCK WAVE MEASUREMENTS. Theoretical Part of Interim Report Covering Research Carried out from January 1, 1959 through December 31, 1959. H. J. Kaeppler, B. Mayser, and K. H. Höcker. Jan. 1960. 148p. Contract AF61(052)-199.

The theoretical investigations constitute a first venture in attempting a general description of shock wave phenomena in plasmas and their applications. Fundamental questions such as a statistical basis for transport equations and conservation laws, limits for description of plasma behavior by macroscopic observables, and the transport equations and conservation laws are discussed. The Rankine-Hugoniot relations for normal shocks in plasmas with external magnetic field in the one-fluid and approximate two-fluid formalism are derived. Shocks in chemically reacting plasmas and in plasmas with radiative emission only are also treated. The application is with respect to plasma shock tubes and the determination of mean effective temperatures in plasmas using shock wave measurements. (auth)

19872 AEDC-TN-59-134

Arnold Engineering Development Center, Tullahoma, Tenn. THE VISIBLE PLASMA FLAME SPECTRA OF ARGON AND HELIUM. W. K. McGregor, J. J. Ehrlich, and J. D. Bratcher. Oct. 1959. 16p. Contract AF40(600)-800. (AD-229965).

The electromagnetic spectrum is employed as a diagnostic tool in research on the kinetics of gases expanding through nozzles. The spectra of argon and helium plasma generated in an electric arc plasma generator were determined. Tables are given of emission lines detected in the range of 3000 to 7000 Å using a grating spectrograph. The spectra are notable for their apparent freedom from

emissions caused by the gas stream contamination and for the distinct appearance of lines attributable to ions. (auth)

19873 AERE-R-3301

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN INVARIANT APPROACH TO EQUILIBRIUM PLASMA DISCHARGES. J. Sparrow. Mar. 1960. 30p. BIS.

Self-consistent solutions for equilibrium discharges were studied by considering various electron distributions constructed via invariants of the motion characterizing the individual particles. In this way the behavior of a plasma subject to magnetic fields was investigated without the use of the macroscopic magnetohydrodynamic equations. (auth)

19874 AFRCR-TN-58-439

Tufts Univ., Medford, Mass.

STUDIES OF A HIGH CURRENT ELECTRICAL DISCHARGE IN AN IONIZED GAS. Scientific Report No. 1. Lewis S. Combes and Samuel P. Zimmerman. June 16, 1958. 62p. Contract AF19(604)-1578. (AD-232258). OTS.

Experiments with a pinched discharge in a toroidal glass tube stabilized by an included magnetic field are described. Photographs taken through an image converter show how the discharge pinches and then becomes unstable. The equivalent circuit of a toroidal discharge and the effect of varying circuit parameters are discussed in an appendix. Experiments using a straight discharge tube are also described. This tube had electrodes at each end and an insulated conductor along its axis so that a current in this axial conductor produced a stabilizing magnetic field fixed in space. Photographs are shown of discharges in this tube that remained stable for approximately 15 to 20 microseconds. (auth)

19875 AFOSR-TN-59-1076

Avco Corp. Avco-Everett Research Lab., Everett, Mass. NUMERICAL CALCULATION OF ABSOLUTE BREMSSTRAHLUNG INTENSITY FOR A FULLY IONIZED FULLY DISSOCIATED HYDROGENIC GAS. Research Report 70. G. Sargent Janes and Harold E. Korlitz. Sept. 1959. 16p. (AD-228740).

Numerical calculations of absolute bremsstrahlung intensities were made on the IBM 650 for a fully ionized, fully dissociated hydrogenic gas. The intensities are given in terms of a quantity having the units ergs per sec per unit frequency interval per steradian per cubic centimeter as a function of $h\nu$, (from 0.5 to 4.0 eV) and kT (from 4 to 200 eV). A calibration method was devised for measurement of absolute bremsstrahlung intensities, which continually compensate for the errors present in most calibration procedures. (auth)

19876 AFOSR-TN-60-576

Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. PART II. WITH LONGITUDINAL APPLIED MAGNETIC FIELD. S. I. Pai. Apr. 1960. 28p. Project 9781. Contract AF49(638)-401. (BN-207).

Wave motions of infinitesimal amplitude in a fully ionized plasma, consisting of singly charged ions and electrons, were investigated by a two fluid theory under uniform external magnetic field. The interaction of the basic modes of wave due to external magnetic field is discussed. The case where the external uniform magnetic field is in the direction of propagation of the waves was analyzed in detail. The two basic transverse waves interact with each other so that two different modes of transverse waves are

formed. In an ideal plasma, two different undamped transverse waves exist in both the low frequency and the high frequency ranges. In the intermediate frequency range, one or both of the transverse waves may change into exponential damped wave which depends on the ratio of the applied frequency to the characteristic frequencies, i.e., ion and electron plasma frequencies and ion and electron cyclotron frequencies. Finally the effect of finite electrical conductivity on these transverse waves was briefly discussed. (auth)

19877 CEA-1439

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

LES SONDES ET LEUR APPLICATION DANS L'ETUDE DES PLASMOIDES H.F. (Probes and their Application to the Study of H. F. Plasmoids). A. Brunet and R. Geller. 1960. 31p.

The single Langmuir probe and the double-probe method are studied. The probe-technique in connection with R.F. plasmoids is discussed. (auth)

19878 CEA-1441

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

INTERPRETATIONS THEORIQUES ET VERIFICATIONS EXPERIMENTALES D'UNE METHODE DE RESONANCE RADIOELECTRIQUE POUR LA MESURE DE LA DENSITE ELECTRONIQUE ET DE LA FREQUENCE DE COLLISION DANS UN PLASMA D'UNE DECHARGE DANS LES GAZ. (Theoretical Interpretations and Experimental Verifications of a Radioelectric Resonance Method for Measuring the Electronic Density and Collision Frequency in a Discharge Plasma in Gases). Nguyen Trong Khol. 1960. 30p.

Theoretical discussions and experimental verifications of one radioelectric resonance method for measuring plasma electronic density and collision frequency are given. (auth)

19879 GA-1442

General Atomic Div., General Dynamics Corp., San Diego, Calif. and Texas Atomic Energy Research Foundation, Dallas.

KINETIC EQUATION WITH A CONSTANT MAGNETIC FIELD. Norman Rostoker. June 29, 1960. 17p. Project No. 30.

The collision operator is derived for the case of a spatially homogeneous plasma subject to a constant external magnetic field. A generalization of Lenard's method is employed. (auth)

19880 ML-654

Stanford Univ., Calif. Microwave Lab.

NONLINEAR EFFECTS IN ELECTRON PLASMAS.

Scientific Report No. 4. P. A. Sturrock. Oct. 1959. 17p. Contract AF19(604)-5226. (AFCRC-TN-59-956; AD-231967).

The effect of nonlinear terms in the dynamical equations governing wave propagation in plasmas is analyzed by a perturbation procedure which is acceptable for amplitudes which are not too large. The Hamiltonian describing the complete system is separated into two parts: the quadratic part which yields the linearized equations, and the nonlinear part. The quadratic part may be eliminated by a normal-mode analysis, the normal modes comprising traveling waves. The nonlinear part then results in interaction between these waves. Two theorems concerning wave interaction are proved. The first relates energy-transfer between a group of interacting waves to the frequency of these waves. These "action-transfer relations" lead to the Manley-Rowe relations for steady-state or

quasi-steady-state configurations. The second theorem relates the frequency-displacements of a group of interacting waves to the energies of these waves. The properties of electron plasmas undergoing longitudinal oscillations are re-examined in the light of the preceding theorems. Interaction terms may be classed as "coherent" and "incoherent": the former do not result in energy transfer but only frequency displacement which may be characterized by a dispersion relation. The second group leads to transfer of energy between waves and hence to spectral decay. The interaction between longitudinal (electrostatic) and transverse (electromagnetic) waves in plasmas is considered, and it is shown that in a uniform plasma in the absence of magnetic fields, the dominant interaction couples two longitudinal waves with one transverse wave. It is anticipated that the dominant nonlinear mechanism for radiation from excited plasmas leads to emission at twice the plasma frequency. (auth)

19881 NP-8840

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

MAGNETIC PLASMA PROPULSION BY MEANS OF A TRAVELLING SINUSOIDAL FIELD. Rudolf X. Meyer. Apr. 30, 1960. 19p. Contract AF04(647)-309. (STL/TR-60-0000-09114).

Paper prepared for the Fourth Symposium on Magneto-hydrodynamics, Lockheed Missiles and Space Division's Research Laboratory, Palo Alto, California, December 2, 1959.

A theoretical model for electrodeless plasma propulsion by means of a time-dependent magnetic field is considered. The plasma is propelled by the peristaltic motion caused by an externally applied traveling magnetic field. The field is sinusoidal and purely transverse in the plane of symmetry. The model is based on the assumption of a fully ionized gas of finite conductivity. The conductivity is assumed to be sufficiently high to permit neglecting the kinetic energy associated with the leakage velocity of the plasma through the magnetic field. The plasma motion is therefore determined by the equilibrium of ponderomotive force and pressure gradient, and is somewhat analogous to the flow of a cold, viscous gas percolating through a porous medium. Temperature and conductivity can be shown to be approximately constant. The quantity of greatest interest is the pressure ratio sustained per half-wavelength of the applied magnetic field. An explicit expression for the case of zero magnetic Reynolds number is given in terms of an integral over the reciprocal of a Legendre elliptic integral. Numerical results are given. (auth)

19882 NP-8880

California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.

EQUILIBRIUM EMISSIVITY CALCULATIONS FOR A HYDROGEN PLASMA AT TEMPERATURES UP TO 10,000°K. Technical Report No. 33. D. Olfe. May 1960. 69p. Contracts Nonr-220(03) and AF18(603)-2.

The important equilibrium emission processes in a hydrogen plasma were investigated in the temperature range between 300 and 10,000°K for pressures up to several hundred atmospheres. Representative emissivity calculations were carried out for a transparent gas at a total pressure of 100 atmos and a mean beam length of 30 cm. Important emissivity contributions were made by the pressure-induced fundamental vibration-rotation band and rotational lines of H₂ at the lower temperatures, i.e., below approximately 4500°K. Above this temperature, the bound-free and free-free transitions of the H⁺ ion and the continuum and line radiation of the H atom are the most important con-

tributors to the emissivity. The following emission processes were investigated: the bound-free transitions of the H_2^+ ion, free-free transitions of colliding H atoms and H^+ ions, electronic transitions of the H_2 molecule, quadrupole vibration-rotation transitions of the H_2 molecule, and vibration-rotation transitions of the HD molecule. The effects of the lowering of the ionization potentials by the fields of plasma ions and of the very broad wings of the Lyman α line were considered. (auth)

19883 NYO-2885

New York Univ., New York. Inst. of Mathematical Sciences.

MAGNETO-HYDRODYNAMIC SHOCK STRUCTURE WITHOUT COLLISIONS. Cathleen S. Morawetz. Mar. 31, 1960. 65p. Contract AT(30-1)-1480. (MF-1). OTS.

A method is presented for studying the internal structure of a magnetohydrodynamic shock in which there are no collisions among the plasma particles. In the case where there is no shock, the ions and electrons pass through a region of changing magnetic and electric field and eventually return to the state from which they started. In the second case, there is a definite change of state. Within the approximation a qualitative picture of the shock is given. The magnetic field rises and then oscillates with a characteristic wavelength about a mean value greater than its initial value. The distribution function of the ions is greatly distorted. The approximation is based on an asymptotic development in the ion-to-electron mass ratio. It is valid over distances that are comparable to or even large compared to the wavelength of the oscillation but small compared to the ion Larmor radius. Therefore, it is quite possible that an improvement in the range of validity of the approximation would show that the oscillation is damped out (e.g., on a length scale comparable to the ion Larmor radius) and that a classical shock exists. The change of state shows that an irreversible process was demonstrated to be possible without collisions. The fields and flows were self-consistent within the approximation. (auth)

19884 RADC-TN-59-348

Brooklyn. Polytechnic Inst. Aerodynamics Lab.

REFLECTION OF AN ELECTROMAGNETIC WAVE AT THE SURFACE OF A PLASMA. Manlio Abele. Oct. 1959. 18p. Contract AF30(602)-2045. (AD-228286).

The particular case of a plane electromagnetic wave of small amplitude, entering a moving plasma through a plane surface at rest, is analyzed. A situation like this is found in the problem of propagation through a stationary strong shock wave. Assuming the classical linearized equation of the electric current inside the plasma, the problem is easily solved. Even in the case of zero collision frequency and a plasma frequency greater than the frequency of the electromagnetic wave, a small fraction of the incident electromagnetic wave can be propagated inside the plasma. (auth)

19885 RADC-TN-59-366

Sylvania Electric Products Inc. Microwave Physics Lab., Mountain View, Calif.

ENERGY TRANSFER IN PLASMAS. Technical Note No. 3. R. F. Whitmer. Nov. 12, 1959. 29p. Project 5561. Contract AF30(602)-2050. (AD-230300).

The effect of collisions on the Boltzmann energy moment equation was studied, and it was found that the collision frequency determined the choice of a parameter to describe the effective number of degrees of freedom of an electron in a plasma. The effect of thermal conductivity on wave propagation in a plasma was investigated. Results indicated that thermal conductivity could be measured by

measuring the wave propagation constant. The propagation of electromagnetic waves in a non-uniform plasma with electron density variations only in the direction of propagation was also studied. An investigation was made of heat conduction in a plasma in which energy was introduced at a given boundary to the electrons alone and then was conducted by both the electrons and the gas. The case was studied first neglecting and then considering inelastic collisions. (M.C.G.)

19886 TID-6184

New York Univ., New York. Inst. of Mathematical Sciences.

SIMILARITY IN THE ASYMPTOTIC BEHAVIOR OF COLLISION-FREE HYDROMAGNETIC WAVES AND WATER WAVES. C. S. Gardner and G. K. Morikawa. May 1, 1960. 30p. Contract AT(30-1)-1480. (MF-2). OTS.

A similarity is found between the behavior of certain waves in a plasma in a magnetic field and gravity waves on the surface of water of finite depth; in both cases, the particular motion studied is caused by a uniformly moving piston, started impulsively from rest. This similarity in behavior develops asymptotically in time away from the initial state, both in the linearized description of the motion and in a more general non-linear small-perturbation description which includes the linear asymptotic motion. The approximate non-linear theory yields the third order differential equation $2w_r + 3ww_r + w_{rrr} = 0$ which can be interpreted as describing a reversible dispersion process, in contrast to Burgers' well-known second order differential equation which describes an irreversible diffusion process. (auth)

19887 ZPh-045

Convair, San Diego, Calif.

PLASMA FLOW OVER A THIN CHARGED CONDUCTOR. H. Yoshihara. June 1959. 17p. Contract AF(604)-5554. (AD-230572).

The flow of a dense plasma over a wavy conducting wall of small amplitude is investigated; the magnetic fields are assumed to be absent. The results were used to analyze the plasma flow over a thin conductor with cusped edges. It is found that the Coulomb drag vanishes identically, while the fluid pressure drag corresponds to the Ackeret value for a neutral particle gas at the reduced plasma Mach number. (auth)

19888

DESIGN AND PERFORMANCE OF A COMPACT SURGE GENERATOR. E. Thornton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). *Brit. J. Appl. Phys.* **11**, 265-8(1960) July.

A compact surge generator for investigation of a fast, linear, pinched discharge using only moderate energy storage is described. The technique of construction using an explosive switch to obtain low inductance, and the method of measuring current are discussed. The behavior of the surge generator when short circuited is determined from the current waveform, and inductance and resistance values are deduced. The inductance and resistance of the switch are much less than those for the whole circuit, with a linear discharge in deuterium. (auth)

19889

MAGNETIC RESONANCE OF THE ATOMIC LEVELS OF ZINC EXCITED BY ELECTRON BOMBARDMENT. Albert David May (École Normale Supérieure, Paris). *Compt. rend.* **250**, 3616-17(1960) May 30. (In French)

The bombardment of atoms with low-energy electrons

produces some polarized rays. This property was used to detect the magnetic resonance of excited levels of even isotopes of zinc. Zinc vapor at a pressure between 10^{-3} and 10^{-4} mm Hg was used as the sample. Four resonances were observed, and the Landé factor was calculated for each. The results are analyzed, and two possible configurations for the excited state are suggested. (J.S.R.)

19890

INFLUENCE OF NEGATIVE IONS ON AMBIPOLAR DIFFUSION OF ELECTRONS. Hendrik J. Oskam and Verlyn R. Mittlestadt (Univ. of Minnesota, Minneapolis). *J. Appl. Phys.* **31**, 940-1 (1960) May.

The disappearance of free electrons in a plasma by diffusion is space-charge limited due to the large difference between the free diffusion coefficients of electrons and positive ions. The diffusion coefficient of electrons, called ambipolar, increases with time if another negative ion species is present. This effect was observed in measurements of the afterglow properties of argon-neon plasmas with a small amount of an impurity, and its magnitude (measured on a frequency shift vs. time graph) increased with the excitation energy for producing the plasma, indicating that the impurity is attached to the container walls and released during each discharge pulse, probably during the build-up period. (D.L.C.)

19891

GREEN FUNCTION METHOD FOR ELECTRON GAS. I. GENERAL FORMULATION. Hideo Kanazawa and Mitsuo Watabe (Tokyo Univ.). *Progr. Theoret. Phys. (Kyoto)* **23**, 408-25 (1960) Mar. (In English)

The Green function method is applied to the problems of electron gas. There is a perfect parallelism between the Green function methods in zero-temperature problems and in finite-temperature problems of systems in thermal equilibrium. It is pointed out that the Green function method is also useful for the calculation of transport quantities. (auth)

19892

GREEN FUNCTION METHOD FOR ELECTRON GAS. II. DISPERSION RELATION OF PLASMONS. Hideo Kanazawa, Setsuo Misawa, and Emiko Fujita (Tokyo Univ.). *Progr. Theoret. Phys. (Kyoto)* **23**, 426-32 (1960) Mar. (In English)

The shift of plasmon energy due to the electron exchange is calculated. The result is the same as that obtained by Nozières and Pines. The analysis of the experimental values of Watanabe referring to Bohm-Pines' values is made and the agreement between theory and experiment seems to be good at high densities. (auth)

19893

GREEN FUNCTION METHOD FOR ELECTRON GAS. III. DIAMAGNETISM. Hideo Kanazawa (Tokyo Univ.) and Noboru Matsudaira (Hōsei Univ., Tokyo). *Progr. Theoret. Phys. (Kyoto)* **23**, 433-46 (1960) Mar. (In English)

The Green function method is applied to the calculation of the diamagnetic susceptibility of a dense electron gas. The exact high density value for the correction to the Landau diamagnetism is calculated. (auth)

19894

STOPPING POWER OF HIGH TEMPERATURE PLASMA. EFFECTS OF IONIC COLLECTIVE MOTION. Yoshi H. Ichikawa (Nihon Univ., Tokyo). *Progr. Theoret. Phys. (Kyoto)* **23**, 512-18 (1960) Mar. (In English)

The problem of energy loss of a charged particle traveling through a fully ionized gas was studied by taking account of effects of ionic motion. Contribution due to an

ionic collective motion turns out to be smaller than that due to an electronic collective motion by an order of m/M , where m is the mass of electron, M that of ion. It is shown that the ionic collective motion cannot be excited by a charged interloper unless one takes into account effects of thermal motion of electrons. (auth)

19895

DETECTION OF ION OSCILLATIONS IN A PLASMA.

M. D. Gabovich, L. L. Pasechnik, and V. G. Yazeva. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1430-3 (1960) May. (In Russian)

Ion oscillations were detected against the noise background of a discharge plasma (charge concentration $\sim 10^{10}$ cm $^{-3}$). The results obtained can be explained by assuming that the probe selectively indicates oscillations with a wave length which is approximately equal to the radius of the ionic layer surrounding the probe. (auth)

19896

INVESTIGATION OF FAST ELECTRONS IN POWERFUL PULSED DISCHARGES. N. G. Koval'skiĭ, I. M. Podgornyi, and M. M. Stepanenko (Inst. of Nuclear Physics, Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1439-45 (1960) May. (In Russian)

The properties of the fast electrons (50 to 300 kev) which produce hard x rays in powerful pulsed discharges are investigated. The dependences of the peak energy of the electron spectrum on the initial pressure and voltage are derived. The effect of an external longitudinal magnetic field on the electron energy is studied. The experiments were carried out in hydrogen, deuterium, and in the inert gases. (auth)

19897

ON MAGNETIC BREMSSTRAHLUNG OF A CONFINED PLASMA. K. N. Stepanov and V. I. Pakhomov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian, SSR). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1564-8 (1960) May. (In Russian)

Magnetic bremsstrahlung of electrons in high-temperature plasma is studied in relation to energy balance control and microwave diagnostics of plasmas. Bremsstrahlung from a confined plasma under magnetic pressure p_H , considerably larger than the pressure of the electron gas p_e , is analyzed. The condition of $p_H \gg p_e + p_i$ (p_i is the ion gas pressure) is taken in order to secure equilibrium plasma configurations and stability. (R.V.J.)

19898

ELECTROMAGNETIC PROPERTIES OF A RELATIVISTIC PLASMA. V. P. Silin. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1577-83 (1960) May. (In Russian)

Dielectric susceptibility which takes into account spatial dispersion is considered for an electron-ion plasma. Expressions are derived for the screening ranges and depth of the skin layer. Undamped and weakly damped plasma oscillations are considered. (auth)

19899

ON THE AMOUNT OF ACCELERATED PARTICLES IN AN IONIZED GAS UNDER VARIOUS ACCELERATING MECHANISMS. A. V. Gurevich (Lebedev Inst. of Physics, Moscow). *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 1597-1607 (1960) May. (In Russian)

The kinetic equation is solved for a system of particles interacting according to Coulomb law under conditions when the distribution function in the high velocity range is not stationary due to the presence of an accelerating mechanism; that is, under conditions when the accelerat-

ing mechanism leads to continuous acceleration of particles whose energy is larger than the injection energy. The magnitude of the particle flux is determined. (auth)

19900

ON THE RELATION BETWEEN THE OSCILLATIONS AND THE RATE OF CHARGED PARTICLE LOSSES IN LOW PRESSURE CYLINDRICAL PLASMA IN LONGITUDINAL FIELD. A. A. Zaitsev and M. Ya. Vasil'eva (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **38**, 1639-40(1960) May. (In Russian)

Positive column plasma oscillations in a constant, longitudinal magnetic field and the influence of the field on the longitudinal potential gradient and the diffusion current to the wall of the discharge tube are investigated. The investigation is made in relation to charged particle transition across magnetic power lines in magneto-ion media and other problems in plasma dynamics. It is postulated that the observed type of oscillations and the related increase in the effective rate of charged particle diffusion losses are the result of a macroscopic shift of the plasma column. (R.V.J.)

19901

INSTABILITY OF INDUCED PINCH. I. F. Kvartskhava, K. N. Kervalidze, and Yu. S. Gvaladze. Zhur. Eksptl'. i Teoret. Fiz. **38**, 1641-3(1960) May. (In Russian)

Photographs of plasma motion in induced (theta) pinch show the close tie between the pinch and the azimuthal heterogeneity of the radial rate of motion in the compression process. It was found that due to such heterogeneity the compressed plasma does not take a cylindrical shape, as was postulated previously, but takes various peculiar deformed shapes. The pictures of characteristic variations in the pinch cross section are presented and analyzed. The analysis shows that in maximum compression the plasma is not in equilibrium; relatively weakly damped intensive macroscopic motion excited in the plasma results in eruptive instability of the pinch. The instability complicated attempts to create high-temperature plasma by pulse processes. The eruptive instability is observed in both rectilinear and toroidal chambers. (R.V.J.)

19902

INVESTIGATION OF THE MAGNETIC TRAP. K. D. Sinelnikov, V. D. Fedortchenko, B. N. Rutkevitch, B. M. Cherni, and B. G. Safronov (Inst. of Physics and Tech., Kharkov). Zhur. Tekh. Fiz. **30**, 256-60(1960) Mar. (In Russian)

Experiments indicating the accumulation of particles in a magnetic trap with a space-periodic field and the formation of a large potential pit for positive ions are describing. (R.V.J.)

19903

THE MOTION OF PARTICLES IN A TOROIDAL MODULATED MAGNETIC FIELD. A. I. Morosov and L. S. Solov'ev. Zhur. Tekh. Fiz. **30**, 261-70(1960) Mar. (In Russian)

The motion of particles in a magnetic trap formed by a modulated toroidal field was studied. It is shown that with sufficiently large toroidal radius and drift approximation the trap is absolute. (tr-auth)

19904

THE INVESTIGATION OF ION CYCLOTRON RESONANCE IN DENSE PLASMA. K. D. Sinelnikov, V. T. Tolok, N. I. Nasarov, I. I. Bakaev, V. A. Bondarev, and Yu. P. Bugaï (Physical Tech. Inst., Kharkov). Zhur. Tekh. Fiz. **30**, 283-8(1960) Mar. (In Russian)

Ion cyclotron resonance in hydrogen plasma, with 10^{12} to 10^{14} particles/cm³, pulse-discharge ionized, and magnetically confined with a 10^4 gauss longitudinal field was investigated. The efficiency of high-frequency energy transmission to the plasma as a function of various parameters was derived. (tr-auth)

19905

ELECTRODYNAMIC ACCELERATION OF PLASMA. I. F. Kvartskhava, R. D. Meladze, and K. V. Suladze. Zhur. Tekh. Fiz. **30**, 289-96(1960) Mar. (In Russian)

Electrodynamic accelerations of plasma in coaxial and induction accelerators were investigated. The experiments show three different groups of plasma bunches appearing in coaxial acceleration. The optimum velocities are determined for both cases. An evaluation was made of the total bunch mass accelerated in a coaxial accelerator per condenser discharge cycle. (tr-auth)

19906

SOME MAGNETO-HYDRODYNAMIC EFFECTS IN PERIOD OF PULSE PLASMA COMPRESSION. I. F. Kvartskhava, K. N. Kervalidze, and Yu. S. Gvaladze. Zhur. Tekh. Fiz. **30**, 297-305(1960) Mar. (In Russian)

Continuous photo-recording of a pulsed plasma pinch in a strong magnetic field is studied. The pictures show the instabilities caused by various formations at the surface of the pinch. Observed plasma ejections are obviously the result of radial shock waves interacting with the surrounding magnetic field and being reflected on the axis of the pinch. An eruptive instability was observed in induction and linear pinches. The results of magnetic field probe measurements are analyzed. (tr-auth)

19907

HIGH-FREQUENCY OSCILLATIONS IN RESTRICTED PLASMA. R. A. Demirchanov, A. K. Gevorkov, A. F. Popov, and G. I. Zverev. Zhur. Tekh. Fiz. **30**, 306-14(1960) Mar. (In Russian)

The nature and mechanisms of excited oscillations in confined plasma at 10^8 to 10^9 Hz are investigated. It is shown that the oscillations are excited by high-frequency secondary electron oscillations in the plasma potential well. Simultaneously, various oscillations are induced with frequencies lower than those of the plasma. The observed oscillations are followed by electromagnetic oscillations. The mechanism of oscillation excitation is suggested. (R.V.J.)

19908

THE INTERACTION OF A CHARGED PARTICLE BEAM WITH PLASMA. R. A. Demirkhanov, A. K. Gevorkov, and A. F. Popov. Zhur. Tekh. Fiz. **30**, 315-19(1960) Mar. (In Russian)

Ultra-high frequency oscillations excited in plasma at 10^8 to 3×10^9 Hz were studied. Longitudinal electrostatic waves were excited by injecting a fast electron beam. An excited frequency band with a maximum intensity at plasma frequency was observed. Electromagnetic emissions with identical frequencies were simultaneously observed outside the plasma. The experimental data are in good agreement with the theoretical. (tr-auth)

19909

RADIATION LOSS IN GAS DISCHARGE PLASMA. V. D. Kirillov. Zhur. Tekh. Fiz. **30**, 320-9(1960) Mar. (In Russian)

The energy loss mechanisms in a stable plasma column stripped from the chamber wall was studied. Experiments were carried out in a cylindrical porcelain unit with dis-

charge currents of several tens of kiloamperes, longitudinal magnetic fields up to 24,000 gauss, and deuterium pressures of 0.2 to 0.01 mm mercury. The half period of the discharge current was near 500 μ sec. The charged particle flux on the chamber walls was found to be small. Experiments with ionization chambers, vacuum spectrographs, and thermoluminophors show that the ultraviolet emission of admixtures carries away a considerable part of the energy transmitted to the plasma. (tr-auth)

19910

ABOUT STABILITY OF A FINE RING PLASMA CONDUCTOR IN MAGNETIC FIELD. Yu. V. Vandakurov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz. 30, 330-37(1960) Mar. (In Russian)

The stability of an annular plasma column inside an ideally conducting channel is studied within the limits of magnetohydrodynamics. It is assumed that the column is slightly curved. It is further assumed that under stationary conditions volume currents are absent, and the medium is ideally conducting and unconfined. It was found that the stability limits for a fine annular column are determined by the same equations used in the case of a cylindrical plasma column. Thus, the stability criteria for an infinite column hold for the fine annular plasma (for the cases where the perturbation wavelength maximum is identical and is equal to the length of the annular conductor). (R.V.J.)

19911

STABILITY OF PLASMA CYLINDER IN HIGH FREQUENCY MAGNETIC FIELD. T. F. Volkov. Zhur. Tekh. Fiz. 30, 497-503(1960) May. (In Russian)

A quasi-stationary, high-frequency magnetic field with sufficiently high amplitude traveling along the axis of a plasma column is capable of stabilizing the plasma in relation to arbitrary, small perturbations. A high-frequency field, rotating along the azimuth, does not produce stabilization. The problem is resolved in hydrodynamic approximation. (tr-auth)

19912

SOME PROPERTIES OF INDUCTIVE GAS DISCHARGE. E. D. Andryukhina, S. E. Grebenshchikova, M. S. Rabinovich, M. D. Raizer, A. Ya. Safronov, and I. S. Shpigel (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz. 30, 529-38(1960) May. (In Russian)

The influence of various phenomena on plasma dynamics was analyzed, including magnetic trapping, skin-effect, and shock waves. Experiments were carried out in axially symmetric homogeneous and heterogeneous magnetic fields in a wide range of frequencies and with various ratios between the inducted and active plasma resistances. The a-c magnetic fields were produced by oscillating discharges of condenser banks. The experiments were carried out in cylindrical glass chambers containing hydrogen and air at 5×10^{-1} to 10^{-2} mm mercury. (R.V.J.)

19913

THE OSCILLATION OF A THIN RING-SHAPED PLASMA COLUMN IN MAGNETIC FIELD. Yu. V. Vandakurov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz. 30, 711-22(1960) June. (In Russian)

The axially symmetric oscillations of a fine annular plasma column without active resistances are analyzed by magnetohydrodynamic approximation. The oscillation frequencies of the column confined in an ideally conducting container and the frequencies of a spiral pinch are found. The cross section for the latter case is somewhat different, indicating the influence of side containment. It is shown that the radial component of the side field in the

plane, containing the axis of the pinch, disturbs the stability. (tr-auth)

19914

THERMONUCLEAR REACTIONS. Kurt Diebner. British Patent 841,387. July 13, 1960.

A method is presented for the ignition of the thermonuclear fuels deuterium and tritium. The thermonuclear reaction is initiated by converging compression shock waves produced by a hollow body of solid or liquid explosives. The generation of high temperatures in the center of the convergence of the shock waves is combined with an increase of temperature generated by concentrated electrical discharges in the fusible nuclear fuels so that the temperature rising effects are superimposed and temperatures necessary for the fusion processes are produced at the center of the converging shock wave. (W.L.H.)

Shielding

19915 ANL-6159

Argonne National Lab., Ill.

MEASUREMENTS OF LIGHT TRANSMITTANCE THROUGH THICK SHIELDING WINDOWS. T. W. Eckels. May 1960. 16p. Contract W-31-109-eng-38. OTS.

A method was developed for measuring the light transmittance of thick shielding windows. The measuring equipment was mounted on the operator side of the window and light passed from outside the cell through a cylindrical access hole in the rear wall opposite the window being measured. These measurements were unaffected by the level of room lighting or movements of personnel in light-colored clothing. The results were reproducible within 2%. Supporting experiments verified the general accuracy of the method and equipment. (M.C.G.)

Theoretical Physics

19916 AFOSR-TN-60-522

Maryland. Univ., College Park.

DISTRIBUTION FUNCTIONS AND QUANTUM STATISTICS. Technical Report No. 179. Robert Ayres. May 1960. 46p.

A new formulation of quantum statistical mechanics is given, in terms of distribution functions. It is shown that all quantities of interest are obtained directly from the distribution of particles in k-space, $N(\kappa, \beta)$ and the reaction operator K (often called the Brueckner K-matrix) which is familiar from stationary-state many-body perturbation theory. An integral equation for $N(\kappa, \beta)$ is found, which can be solved by a converging iteration process. Some remarks are included on the application of the virial theorem to systems characterized by zero pressure. (auth)

19917 NP-8785

Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas. CAUSALITY AND DISPERSION RELATIONS FOR FIXED MOMENTUM TRANSFER. H. M. Nussenzveig. 1959. 36p. (Notas de Física Vol. V, No. 19).

To investigate which physical assumptions are relevant to the validity of dispersion relations for fixed momentum transfer, the case of scattering of a classical scalar field by an arbitrary spherically symmetric scatterer of finite radius was treated. To relate the scattering amplitude for fixed momentum transfer with the principle of strict causality, a representation for this amplitude in terms of the scattered wave at finite distances from the scatterer was introduced. The results are partially extended to the scattering of Schrödinger particles. (C.J.G.)

19918

ON THE FORMATION OF METASTABLE COMPLEXES WITH ELEMENTARY PARTICLES. V. P. Shmelev (Lomonosov Moscow State Univ.). *Nauch. Doklady Vyssheĭ Shkoly. Fiz.-Mat. Nauki* No. 2, 146-8(1959). (In Russian)

The results are given of calculations made of the simplest proton-electron-positron molecule, obtained as the solution of the Schroedinger equation for two particles (electron and positron) in the field of a fixed proton with charge e^+ . The ground state with the smallest energy level was calculated. The wave function and the ground state energy were found by variational methods. The experimental function was selected with consideration that such a system is impossible from the point of view of classical electrodynamics, i.e., that the particles are bound by exchange forces of a quantum nature (such a bond was found with hydrogen ions). (R.V.J.)

19919

ON THE THEORY OF NUCLEAR MATTER. G. M. Vagradoy and D. A. Kirzhnits (Lebedev Inst. for Physics, Moscow). *Zhur. Eksptl'. i Teoret. Fiz.* 38, 1499-1506 (1960) May. (In Russian)

A simple method is proposed for quantitatively describing the ground state of nuclear matter. It is demonstrated that the gas approximation with a modified nucleon dispersion law can be employed. The error of the method does not exceed that of the empirical quantities. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

19920 AEEW-M-23

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.

THE DESIGN AND MAINTENANCE OF THE CALDER HALL REACTOR SIMULATOR. E. R. Corran. Nov. 1959. 16p.

This manual deals with the design and general maintenance of the individual computing units associated with the reactor simulator. It is intended to be an aid to servicing the device rather than an explanation of the detailed working of the units, though this was included in some parts where it is felt it would be found helpful. (auth)

19921 AEEW-M-33

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.

A RECORD/REPLAY SYSTEM FOR THE HARMONIC ANALYSIS OF NUCLEAR REACTOR FLUX NOISE. L. A. J. Lawrence and E. R. Corran. Feb. 1960. 31p. BIS.

The design of a record/replay system for the determination of neutron flux spectra is discussed and circuit details and performance figures are given. Frequency modulation is used with a carrier frequency of 1000 cps, the complete system having an over-all bandwidth of 100 cps. The noise is recorded on magnetic tape and when replayed is analyzed into a spectrum by means of a selective amplifier used in conjunction with an infinitely variable speed control on the tape. It is shown that if the lowest spectral frequency is 0.01 cps a recording time of many hours is necessary. The DIDO noise spectrum is analyzed and shown to be contained in a bandwidth of a few cycles per second. (auth)

19922 ANL-4965

Argonne National Lab., Ill.
HELIUM LEAK DETECTOR TEST FOR HANFORD AND SAVANNAH RIVER FUEL SLUGS. A. H. Barnes, F. A. Smith, and E. A. Wimunc. Dec. 31, 1952. Decl. Mar. 3, 1960. 12p. Contract W-31-109-eng-38. OTS.

A He pressurizing vessel is described which has been used for detecting the presence of minute holes, cracks, and fissures in the Al jackets of reactor fuel slugs which would allow moisture to penetrate to the U during reactor operation. Slugs may be tested in batches of ten, allowing examination of 200 slugs per hour with a single machine. Any batch which shows excessive He absorption and subsequent release, as measured with a He leak detector, is tested individually to locate the defective slug. (C.H.)

19923 ANL-6016

Argonne National Lab., Ill.
ARGONNE LOW POWER REACTOR HEALTH PHYSICS MANUAL. E. D. Graham and P. G. Stoddart. Aug. 1959. 125p. Contract W-31-109-eng-38. OTS.

The Argonne Low Power Reactor (ALPR) Health Physics Manual is designed for use by Department of Defense personnel with limited experience and training in applied radiation safety techniques. The treatment is nonmathematical and is directed toward specific use with the ALPR. Included is a brief summary of initial operating experience and a series of detailed operating instructions. (W.L.H.)

19924 ATL-A-108

Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.

VARIABLE MODERATOR REACTOR DEVELOPMENT PROGRAM. Quarterly Progress Report No. 4. May 31, 1960. 86p. Contract AT(04-3)-250, Project Agreement No. 3. OTS.

Work on the parametric studies, coupled with the partially completed economic evaluation, showed that: (1) a moderator-to-coolant volume ratio of at least 0.45 is required in order to obtain sufficient reactivity worth in moderator-reflector region of the VMR to control the reactor; (2) stainless steel-clad fuel appears to be more attractive economically than Zircaloy-clad fuel; and (3) fuel-cycle costs are more sensitive to reductions in specific power brought about by reductions in coolant-to- UO_2 ratios than they are to changes in conversion ratio brought about by changes in total H_2O -to- UO_2 ratios. The VMR analytical kinetic model showed that the reactor can be made to be stable and load-following for both positive and negative reactivities with a simple control system. The blackness method of computing the PUREE' thermal group constants produces negligible differences for lattices of interest, as compared to those determined by the P_3 -POP method. The value of K_{eff} computed by PUREE' techniques for the critical experiment appeared to be about 3% higher than the experimental values obtained on VMR-type lattices. (For preceding period see ATL-A-107.) (W.D.M.)

19925 BAW-1160

Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.

THORIUM URANIUM PHYSICS EXPERIMENTS (TUPE). Monthly Report, August 3, 1959. N. L. Snidow. Aug. 6, 1959. 10p. Contract AT(11-1)-766. OTS.

Objective of the research is to perform a series of critical experiments on H_2O moderated cores containing thorium oxide-uranium oxide aluminum clad pins with metal to water ratios in the range of 0.5 to 1.0. The

program is an extension of critical experiments performed for the Consolidated Edison Thorium Reactor which utilized the same fuel pellet in stainless steel clad pins with M/W ratios of 1. The status of the project, objectives, core descriptions, and an outline of the proposed measurements are given. (W.D.M.)

19926 BAW-1173

Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.

THORIUM URANIUM PHYSICS EXPERIMENTS (TUPE).

Monthly Report for September 1959. R. C. Anderson, M. L. Batch, R. H. Lewis, N. L. Snidow, and W. M. Vannoy. 29p. Contract AT(11-1)766. OTS.

The cores to be studied are described, and the status of the project is given. The results of measurements on core 25√2B are discussed in terms of critical mass, perturbation of M/W, thermal disadvantage factor, buckling, and cadmium ratio experiments. (W.D.M.)

19927 BAW-1193

Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.

THORIUM URANIUM PHYSICS EXPERIMENTS (TUPE).

Monthly Report for February 1960. N. L. Snidow. 7p. Contract AT(11-1)766. OTS.

The status of the project is summarized, and the results of clean core measurements on Cores 15B and 15A are given. (W.D.M.)

19928 CF-60-6-102

Oak Ridge National Lab., Tenn.

AUTOCORRELATION FUNCTIONS AND OPERATIONAL-

SAFETY ANALYSIS. Paul R. Kasten. June 24, 1960.

16p. Contract [W-7405-eng-26]. OTS.

The use of autocorrelation functions in noise analysis and the subsequent application of noise analysis to determine operational safety are discussed. Pertinent to an evaluation of reactor noise analysis data, a review is made of reactor stability, transfer functions, characteristic equations, Nyquist stability criteria, and frequency response plots. (C.J.G.)

19929 CNC-30

Italy. Comitato Nazionale per le Ricerche Nucleari.

Divisione Studi e Ricerche, Rome.

THERMAL UTILIZATION FACTOR CALCULATIONS FOR

REACTOR CELLS. (Calcoli del Fattore di Utilizzazione

Termica Relativi a Cella di Reattore). V. C. Boffi and

V. G. Molinari. May 1960. 18p.

A previously determined recurrence formula is applied to the calculation of the thermal utilization factor for the case of reactor N-region cells. The cases considered were both plane and cylindrical geometry with fuel in varying positions. (C.J.G.)

19930 CRRL-940

Atomic Energy of Canada Ltd., Chalk River, Ont.

DECONTAMINATION OF THE X-3 LOOP PRESSURE TUBE USING ALKALINE PERMANGANATE AND AMMONIUM CITRATE SOLUTIONS. G. M. Allison, S. P.

Gibson, J. A. Atherley, and D. McLaughlin. June 1960. 29p. (AECL-1041). AECL.

The decontamination of the pressure tube from the X-3 Loop in the NRX Reactor was carried out using alkaline permanganate and ammonium citrate solutions. Decontamination factors obtained for uranium and for the major corrosion-product activities were in the range 1.5 to 2.1, considerably lower than those obtained in laboratory-scale tests. These decontamination factors were very similar to those obtained in the decontamina-

tion of the X-3 loop using the BAPL COD (S. 4) solution.

Of the nuclides determined in the decontaminants, Zr⁹⁵ and its daughter Nb⁹⁵ were the most predominant. The activation product Ta¹⁸² was also identified and determined. The decontamination removed 10.8 mg U from the pressure tube, of this 90% appeared in the alkaline permanganate solution. This solution also contained 40 to 50% of the Zr⁹⁵, Fe⁵⁹ and Ta¹⁸² found, but only 2% of the Co⁶⁰ and Co⁵⁸. (auth)

19931 HW-35674

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A DISCUSSION OF TECHNIQUES FOR OPTIMIZING FLUX

AND POWER DISTRIBUTION. G. C. Fullmer, R. O.

Brugge, and J. H. Brown. Mar. 3, 1955. Decl. Apr. 15, 1955. 3p. OTS.

19932 HW-55785

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRESSURIZED WATER SYSTEMS—SELECTED PROBLEMS.

W. J. Gartin. Apr. 18, 1958. 6p. Contract

AT(45-1)-1350. OTS.

An outline of problems encountered in the operation of high-temperature pressurized water systems and the action taken to solve them is presented. Opinions on the significance of this experience in connection with future reactors are also included. (J.R.D.)

19933 HW-64965

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DEVELOPMENT OF PRESSURE TUBING FOR THE

PLUTONIUM RECYCLE TEST REACTOR. J. W. Riches.

Apr. 28, 1960. 10p. Contract AT(45-1)-1350. OTS.

The design and fabrication of pressure tubing for the Plutonium Recycle Test Reactor are reported. The tubing is composed of Zircaloy-2 and has a design stress of 14,000 psi at a 550°F operating temperature. A program to monitor the in-reactor behavior of the process tubes is discussed. (C.J.G.)

19934 IDO-16610(Pt.I)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CALIBRATION OF RMF CONTROL ELEMENTS. E. Fast

and D. A. Millsap. Apr. 19, 1957. 29p. Contract AT

(10-1)-205. OTS.

Calibration procedures for the Reactivity Measurement Facility (RMF) regulating and shim rods are given. Calibration data for the RMF control elements are presented in tabular form. (C.J.G.)

19935 IDO-16610(Pt.II)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CALIBRATION OF RMF CONTROL ELEMENTS: II.

RECALIBRATION OF THE REGULATING ROD. D. A.

Millsap and E. Fast. Jan. 5, 1959. 17p. Contract AT

(10-1)-205. OTS.

A recalibration procedure for the Reactivity Measurement Facility (RMF) was made due to modifications to the RMF. Graphs of the regulating rod positions as a function of reactivity are presented. (C.J.G.)

19936 IDO-16610(Pt.III)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CALIBRATION OF RMF CONTROL ELEMENTS: III.

RECALIBRATION OF REGULATING ROD. E. Fast,

D. A. Millsap, and G. K. Wachs. Aug. 27, 1959. 18p.

Contract AT(10-1)-205. OTS.

A recalibration of the Reactivity Measurement Facility regulating rod was made after the rod was disturbed in its normal placement. Calibration procedures and tables are contained. (C.J.G.)

19937 IGR-TN/R-760

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

STATISTICAL METHODS FOR THE ESTIMATION OF MAXIMUM FUEL ELEMENT TEMPERATURE. A. Hitchcock. Jan. 1958. 10p. BIS.

A statistical method of analyzing observations of fuel element temperature in order to estimate the maximum temperature was developed. Forty to sixty, and no less than thirty, measurements of fuel element temperature were required if uncertainties in the temperature distribution were not to result in unnecessary loss of efficiency. (M.C.G.)

19938 KAPL-M-DBM-1

Knolls Atomic Power Lab., Schenectady, N. Y. SOURCELESS STARTUP—A MACHINE CODE FOR COMPUTING LOW-SOURCE REACTOR STARTUPS. D. B. MacMillan. June 1, 1960. 23p. Contract W-31-109-Eng-52. OTS.

The Sourceless Startup code, which solves a system of differential equations, is described. It is used in computing the probability distribution of reactivity at an observed power level during startup of a reactor from a very low source level. (auth)

19939 KAPL-M-FP-1

Knolls Atomic Power Lab., Schenectady, N. Y. ESTIMATE OF THE DESIGN USEFUL LIFE OF THE SAR-PTR REACTOR PRESSURE VESSEL HEAD. (Based on Stresses at the Edge of the Central Hole). F. Panlilio and R. Eisenstadt. June 3, 1960. 23p. Contract W-31-109-eng-52. OTS.

The estimated safe life of the KAPL Proof Test Reactor (PTR) pressure vessel head was determined relative to the stresses at the edge of the central hole. The major thermal stresses are shown to depend not only on the deviation from linearity of temperature variation but on the non-symmetry of such deviation as well. A simple and useful method for quick evaluation of such stresses for any known temperature deviation that requires no analytical approximations is described. Under the usual operating conditions for PTR as determined by tests that indicate only a limited amount of stress reversal, the expected design life is 50,000 cycles. It was noted that maintaining the pressure during the cooling part of the operational cycle prevented reversal of stresses in the critical bottom side; this conferred on the vessel head a potential additional 450,000 cycles of useful life. (auth)

19940 MSAR-60-78

MSA Research Corp., Callery, Penna. PROGRESS REPORT NO. 58 FOR APRIL AND MAY 1960. W. J. Posey, ed. June 24, 1960. 19p. Contract NObs-77023.

Research is continued pertaining to reactor coolant problems. The development and testing of components to determine if performance is adequate are discussed. The experimentation in which test results are evaluated by chemical or radiochemical techniques is included. (For preceding period see MSAR-60-49.) (B.O.G.)

19941 NAA-SR-Memo-3092

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

REACTOR BURNUP OF POISONS IN COMMERCIAL

GRAPHITES. S. C. Carniglia. Sept. 15, 1958. 20p. OTS.

The effects of thermal neutrons on commercial graphites were investigated relative to the reactor burnup of poisons. Curves are presented which show the macroscopic cross section of B, Cd, Eu, Gd, In, Li, and Sm as a function of exposure to thermal neutrons. The improvements in cross section of several commercial graphite grades during reactor operation are compared. (C.J.G.)

19942 NAA-SR-Memo-5064

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

MEASUREMENT OF RADIATION ABOUT THE GRAPHITE CRITICAL FACILITY. C. H. Skeen. Mar. 10, 1960. 11p. OTS.

Radiation surveys were made at several operating power levels up to 27 watts at all accessible points around the ASGR Graphite Critical Facility. At a power of 27 watts, it was found that the radiation dose rate would not exceed 2 mr/hr at any point normally accessible to personnel. (C.J.G.)

19943 NAA-SR-Memo-5168 (Rev. A)

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A SIMPLIFIED TWO GROUP METHOD FOR CALCULATING REACTOR LIFETIME BEHAVIOR. R. Sevy. June 3, 1960. 12p. OTS.

A two-group method is described for determining the changes in reactor composition and reactivity with energy release. It is recommended that this procedure be coded in Fortran for use on the IBM 709. (J.R.D.)

19944 NDA-2-19

Nuclear Development Associates, Inc., White Plains, N. Y. A SURVEY OF CONTEMPORARY MULTIGROUP CODES FOR THE SOLUTION OF REACTOR CRITICALITY PROBLEMS ON FAST DIGITAL COMPUTERS. R. Liedtke. Feb. 24, 1955. Decl. Feb. 16, 1960. 131p. Contracts Nonr 1258(00) and AT(30-1)-862. OTS.

A survey was made of a number of multigroup codes for the solution of reactor problems on fast digital computers. An attempt is made to compare these codes relative to the approximations used in setting up the equations upon which they are based, and their flexibility for the solution of a wide range of specific reactor problems. A chart is given which outlines the gross features of the codes. (auth)

19945 NP-8848

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

EXPERIMENTAL REACTOR PHYSICS RESEARCH BY 1960 CARRIED OUT IN THE EXPERIMENTAL REACTOR PHYSICS GROUP. W. Dąbek. 1960. 36p.

A condensed report is presented on the experimental activities of the Experimental Reactor Physics Group and of the Reactor Detectors Group in the Institute of Nuclear Research, Warsaw, in the period 1958 to 1960. Described are some experimental techniques developed, e.g.: neutron and gamma flux detection techniques, filter methods, slow neutron chopper measurements, activation analysis, and pile oscillator techniques. Attention is drawn to such experimental apparatus as detectors, neutron energy analyzers, pile oscillator, pulsed neutron sources, as well as to major facilities (graphite and water exponential assemblies). The main research effort is directed toward collection of reactor data important for the design of the Second Polish Research Reactor which will be preceded by a critical mock-up of similar design. (auth)

19946 NP-8850

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

WORK IN THE FIELD OF APPLIED REACTOR THEORY DONE BY THE REACTOR THEORY GROUP IN THE REACTOR ENGINEERING DEPARTMENT OF THE INSTITUTE OF NUCLEAR RESEARCH OF THE POLISH ACADEMY OF SCIENCES IN THE PERIOD 1958-1960.

R. Żelazny. 1960. 26p.

Extensive studies leading to the choice of a proper type for the second experimental Polish reactor involved the development of methods applicable to calculations of critical assemblies of water moderated and cooled reactors. Critical parameters for enrichments from 5 to 20%, water volume fractions from 0.5 to 0.8, and U^{235} concentrations from 11 to 66 g/l were calculated. Neutron flux distribution was determined for water moderated and cooled reactors with graphite side reflectors. Heavy water reactors considered had fuel rods of metallic uranium, were heavy water moderated, heavy or light water cooled, and graphite reflected. Critical parameters were calculated for enrichments of 0.714, 2, 5, and 20% and for fuel rod radii of 0.50, 0.75, and 1 cm. Three graphite moderated reactors were considered and criticality studies made on each. The first was a low-enrichment, gas cooled reactor, called PILOT, designed for fundamental research. The second was an experimental, natural-uranium, gas cooled reactor called PERUN. The third was a water cooled reactor. Computations were made on two large loops with liquid carrier circulation. The loops were designed for the fluid to become activated in the reactor and then to serve as a gamma source in a special radiator designed for irradiation of chemicals. $In_2(SO_4)_3$ and In-Ga eutectic were chosen as the carriers. The adequacy of formulas developed from oscillator theory for solving actual problems was determined. Neutron temperature measurements, made in a parallel beam by a filter method, were analyzed. Application was made of Jacobi and Gegenbauer polynomials to neutron transport problems involving the use of the Boltzmann equations in constant cross section approximations. (M.C.G.)

19947 NYO-2701

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

STUDY OF SLIGHTLY-ENRICHED URANIUM-WATER LATTICES WITH HIGH CONVERSION RATIO. Quarterly Progress Report [for] May 1 to July 31, 1959. 36p. Contract AT(30-1)-2379. OTS.

A study of resonance capture and of the effect of fast fission and capture on the conversion ratio in slightly enriched uranium-water lattices is reported. A review was made of theoretical methods available for the calculation of resonance effects which resulted in detailed numerical comparisons between the predictions of several of the most complete schemes. The extension of the analytical theory of resonance absorption to include strong lattice effects appears to give results that agree well with exact Monte Carlo calculations. A summary of the pertinent theory and some of the preliminary calculations is given. In order to gain some insight into the effect of fission in U^{238} and epithermal absorption in U^{235} on conversion ratio and reactivity, a two-group description was derived mostly in terms of measurable quantities. The resulting formulas show in a simple way how the high epithermal α of U^{235} tends to diminish the improvement in conversion ratio produced by fission in U^{238} . (For preceding period see NYO-2700.) (W.D.M.)

19948 TID-6116

General Dynamics Corp. Electric Boat Div., Groton, Conn.

A METHOD FOR MEASURING THE SPECIFIC ACTIVITY OF RADIOACTIVE COOLANT IN A PIPE. E. Czapek, R. Gulino, K. Hall, J. Shapiro, W. Welte, and A. Wong. Feb. 1960. 27p. OTS. (RAS-11U).

A method was developed to determine the specific activity of the radioactive coolant in a pipe in a nuclear power plant without requiring any alterations on the coolant system. The method involves the measurement of the dose rate from a geometrically defined portion of the primary coolant pipe with a special collimator and a theoretical analysis to relate the dose rate reading to the specific activity of the gamma source of a known energy spectrum contributing to the dose rate. Equations are presented for applying the method to measure the N^{16} specific activity in pressurized water plants. (auth)

19949 WAPD-BT-18(p.107-34)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

BURNUP LIMITATIONS OF BULK UO_2 PROTOTYPE FUEL ELEMENTS—AN INTERIM EXAMINATION OF THE CR-IV-X-3-1 TEST AND AN INTERIM EXAMINATION OF THE CR-V-m EXPERIMENT. M. L. Bleiberg, G. Maskarinec, D. Clark, and W. Yeniscavich. p.107-34 of BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY.

A definite burnup limitation of bulk UO_2 was found to exist at about 16 to 21.5×10^{20} fissions/cc (about 45,000 to 60,000 MWD/T of UO_2 , 7 to 9 at.% U fissioned), at which point the fuel increased in volume 4 to 5%, the UO_2 crystal lattice was destroyed, and the fission gas release was increased by almost two orders of magnitude over that at burnups of about 8×10^{20} fissions/cc. Under the same exposure conditions, UO_2 which was exposed to high temperature water increased in volume about 25%. Premature failures of fuel compartments were observed through "waterlogging-type" failures and also by accelerated corrosion of excess copper contaminated Zircaloy cladding which resulted in the formation of brittle hydride at fuel plate edge margins. (auth)

19950 WAPD-TM-213

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

STDY-3, A PROGRAM FOR THE THERMAL ANALYSIS OF A PRESSURIZED WATER NUCLEAR REACTOR DURING STEADY-STATE OPERATION. R. S. Pyle. June 1960. 45p. Contract AT(11-1)-GEN-14. OTS.

A digital program to perform a steady-state, parallel channel thermal analysis of a rectangular water channel nuclear reactor with a plate-type fuel element is described. Features that automatically vary certain input values to aid in parametric studies are included. The program was assembled by the FORTRAN compiler for a 16,000 word IBM-704 computer, including three tape units and one logical drum. (auth)

19951 AECL-1011

SURVEY OF SOVIET REACTORS (STATUS ACCORDING TO PUBLISHED REPORTS UP TO SEPTEMBER 15, 1958). Translated by F. Oravec from *Jaderná energie* 5, 92-101 (1959). 14p. AECL.

A survey of Soviet reactors up to September 15, 1958, is presented in the form of tables giving the name, purpose, power, maximum neutron flux, data when put into operation, location, fuel, moderator, reflector, coolant, and miscellaneous notes on lattices, etc. A bibliography of 64 references is given. (D.L.C.)

19952

NEW DEVELOPMENTS IN REACTOR DESIGN AND LAYOUT. A. N. Komarovskii. *Atomnaya Energ.* 8, 505-13 (1960) June. (In Russian)

Site selection for reactor buildings and construction schemes are analyzed. The advantages and disadvantages of surface and underground locations and concrete shielding for stationary power reactors are discussed. The problems of containment shells and economics of various concrete shielding compositions for biological protection are studied. (tr-auth)

19953

THE EFFECT OF A DIAGONAL CONTROL ROD IN A CYLINDRICAL REACTOR. T. Nilsson and N. G. Sjöstrand (AB Atomenergi, Stockholm). *Nuclear Sci. and Eng.* 8, 12-13(1960) July.

A thin cadmium rod, corresponding to a control rod in a reactor, was placed diagonally in a cylinder containing water. The change in time decay constant of the neutron flux was measured and interpreted as a change in the geometric buckling of the system. The measurements were performed for various ratios of height to radius of the cylinder. The results were compared with calculations where the effective thickness of the rods was estimated in two different ways and the total effect of the rods was obtained by a weighting procedure. The measured values fell between the two calculated curves. (auth)

19954

THE RICE FORMULATION OF PILE NOISE. Edgar F. Bennett (Argonne National Lab., Ill.). *Nuclear Sci. and Eng.* 8, 53-61(1960) July.

Spectrum and variance of pile noise are discussed according to the formulation of S. O. Rice. It is shown that variance diverges as criticality is approached. A convergent quantity closely related to variance is introduced and observations on this quantity taken with ZPR-IV, a light water-moderated highly enriched source reactor at Argonne. (auth)

19955

CONCEPT OF AN INDUSTRIAL SCALE FACILITY FOR NON-DESTRUCTIVE ANALYSIS OF IRRADIATED FUEL ELEMENTS. Wacław Frankowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). *Nukleonika* 5, 23-6(1960). (In English)

A new concept is presented of a facility for determining the burnup of power reactor fuel elements using a critical assembly. The facility allows burnup measurements without injuring fuel element cans or altering their nuclear and mechanical properties, and creates a possibility of attaining high burnups using a "shuffling" process. (auth)

19956

IMPROVEMENTS RELATING TO PROTECTIVE EQUIPMENT FOR NUCLEAR REACTORS. Anthony Edward Thomas Nye. (to British Thomson-Houston Co., Ltd.). British Patent 834,908. May 11, 1960.

The design of independent circulators for coolant passages of a gas-cooled reactor in event of a failure of circulation gas is presented. (W.L.H.)

19957

IMPROVEMENTS IN NUCLEAR REACTOR FUEL ELEMENT HANDLING PLANT. Richard Arthur Taylor (to Babcock & Wilcox Ltd.). British Patent 836,562. June 1, 1960.

The design of apparatus for conveying fuel elements withdrawn from a reactor is presented. The conveying means is a chute for leading fuel elements from a higher level to a place of discharge at a lower level. (W.L.H.)

19958

CENTRAL CONTROL SYSTEM. (to United Kingdom Atomic Energy Authority). British Patent 837,191. June 9, 1960.

An apparatus is described for controlling fission in a reactor. The apparatus consists of a coiled spring control mechanism of neutron-absorbing material arranged so that it can undergo compression or expansion for changing its effective length. (W.L.H.)

19959

A STEAM STIRRED HOMOGENEOUS NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 840,740. July 13, 1960.

The design of a homogeneous reactor is described. The removal of heat in the critical region is accomplished by utilizing the steam bubbles formed in the critical region. There are small diameter tubes extending upwardly in the critical region to which the liquid fuel is directed upward and down the adjacent annular area containing heat exchanging apparatus and back into the critical region of the reactor. The reactor is primarily controlled by a negative temperature coefficient of reactivity, and the power level may be adjusted by regulating the flow of cooling fluid. (W.L.H.)

Power Reactors

19960 AEEW-M-19

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.

FREQUENCY SPECTRUM OF CALDER HALL REACTOR NOISE. J. D. Cummins. Jan. 1960. 22p. BIS.

The frequency spectrum of the noise power of Calder Hall Reactor No. 1 was obtained by analyzing a tape recording of the backed off power. The rms noise power due to all frequencies above 0.001 cps was found to be 0.13%. The noise power for this reactor is due mainly to modulations of the power level by reactivity variations caused in turn by gas temperature changes. These gas temperature changes are caused by a cyclic variation in the feedwater regulator to the heat exchanger. The apparatus and method used to determine the noise power are described. It is shown that for frequencies in the range 0.001 to 0.030 cps the noise spectrum falls at 60 decibels per decade of frequency. (auth)

19961 AGN-TM-376

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM:
UTILIZATION OF THE GCRC-I IN SUPPORT OF THE ML-1A PROGRAM. May 6, 1960. 18p. Contract [AT(10-1)-880]. OTS.

A study was carried out on the Gas-cooled Systems Experiment (GCSE), now a skid-mounted prototype known as ML-1, in order to evaluate the optimum utilization of its GCRC-1 facility from June 1960 to June 1962. The GCRC will serve as a fuel element (core) test facility, and it is hoped that a ML-1A fuel element with a lifetime of 10,000 hours can be developed. Other items to be studied are pin-type fuel element lifetime, reactor component behavior, and shielding adequacy. Funds available for the proposed program are outlined. (D.L.C.)

19962 ANL-6028

Argonne National Lab., Ill.
THERMAL CYCLING OF EBR-I, MARK III FUEL. G. K. Whitham and E. S. Sowa. Apr. 1960. 26p. Contract W-31-109-eng-38. OTS.

A brief description of the EBR-I, Mark III fuel fabrication process is followed by an exposition of the thermal cycling tests on fuel samples. Results of these tests, coupled with observations on the irradiation behavior of the fuel, resulted in the selection of the optimum heat treatment subsequently used in the fabrication of the Mark III core loading. (auth)

19963 ANL-6124

Argonne National Lab., Ill. and Land-Air, Inc., Chicago. THE INTERNAL FEEDBACK OF EBR-I MARK-III. J. C. Carter, D. W. Sparks, and J. H. Tessier. Feb. 1960. 72p. Contract W-31-109-eng-38. OTS.

The reactor is considered to constitute a closed-loop, nonlinear mechanical system with forcing functions resulting from variations in neutron density and the flow of NaK. The significant sources of internal feedback are found to be the variation in volume of the uranium and the variation in the density of NaK. Resistance to the free motion of uranium in response to thermal expansion accounts for the significant nonlinear properties of the system. This resistance results from the physical characteristics of the redundant structure constituting the core, blankets and containing shell. The mechanical system is transformed into a dynamically similar electronic system which is subject to the transformed operating conditions of the reactor. All the equations defining the time-dependent physical phenomena were developed from an analysis of the mechanical system. Only the constants in the nonlinear equations of motion of the materials of the core and blankets were synthesized from low-power operation of the reactor. The relationship between signal and response of the two systems is in good agreement over all conditions of operation. (auth)

19964 ANP-65(Del.)

Oak Ridge National Lab., Tenn. AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 10, 1951. W. B. Cottrell, ed. Sept. 13, 1951. Decl. with deletions Nov. 16, 1959. 181p. Contract W-7405-eng-26. OTS.

The design status of the ARE is summarized briefly. Extensive calculations of reflector effects with the 3-ft ARE core for several reflector compositions and thicknesses are presented. The calculated reactivity of the first experimental Be-U critical assembly is 0.90 for a configuration which actually was just critical, i.e., a reactivity of 1.00. Static-corrosion tests for 100 hr at 800°C on types 304, 316, 321, and 316 stainless steel and Inconel by the outgassed NaF-BeF-UF₄ fuel mixture resulted in average depths of attack of 2.5, 1.5, 1.0, 2.0, and 5.0 mils. respectively. Thermal capacities were determined for Zr, nickel A, and stainless steel. The thermal conductivities of Fe and Al were measured. An electronic welding technique was developed for the semi-automatic welding of small-diameter tubing. The creep rate of 347 stainless steel under irradiation was 25% lower than that of a similar but unirradiated creep specimen. The temperature contours of the ternary fluoride systems NaF-BeF₂-UF₄, NaF-KF-UF₄, NaF-RbF-UF₄, RbF-BeF₂-UF₄, and NaF-PbF₂-UF₄ were determined. (W.L.H.)

19965 APAE-Memo-230

Alco Products, Inc., Schenectady, N. Y. SIMPLIFICATION OF SAFETY AND ALARM SYSTEMS FOR THE SM-2. S. H. Birken. Dec. 12, 1959. 74p. Contract DA-44-192-ENG-7.

Knowledge gained from SM-1 (APPR-1) operational experience is used to aid in simplifying the SM-2 scram and

alarm system. The criteria of burnout heat flux ratio is used to determine scram settings. The start-up behavior and the behavior of the SM-2 at power are investigated in terms of burnout heat flux ratios. It is shown that the high-pressure primary coolant scram, high-temperature steam scram, and the high-pressure steam scram originally in the SM-1 control design may be eliminated in the SM-2 control system. The period scram may be eliminated from the SM-2 control system for powers greater than 2Mw(th) because of the inherent stability of the SM-2 pressurized water reactor. (auth)

19966 APAE-Memo-237

Alco Products, Inc., Schenectady, N. Y. SM-1—RESEARCH AND DEVELOPMENT QUARTERLY REPORT [FOR] JULY 1, 1959 TO SEPTEMBER 30, 1959. J. O. Brondel, W. S. Brown, C. H. Harvey, R. A. Hasse, R. E. May, J. H. Morrison, S. S. Rosen, W. E. Schleicher, R. S. Stein, D. C. Tubbs, and G. J. Vodapivc—C. H. Obrist, comp. Jan. 15, 1960. 118p. Contract AT(30-3)-326. OTS.

A survey of SM-1 water chemistry methods was initiated, covering present water treatment chemicals, chemical analysis, and purification methods. Two possible technical overexposures were investigated. A set of criteria for evaluating the controls and instrumentation was prepared. The originally proposed 30% capacity steam by-pass line was superseded by a 100 capacity steam dump line. Various methods of instrumenting fuel plates are considered. A high probability of obtaining a bond was indicated by the introduction of a thin layer of a third material that is mutually bondable to both the stainless steel and the zirconium. Some task activity is continuing on the instrumentation method of imbedding thermocouples in fuel plate cladding. Test procedures were prepared for sampling crud, water, and metal coupons for the determination of long-lived dose rates. Test procedures were prepared for fission product monitoring and for studying the behavior of I¹³¹ and I¹³³ during startup and shut down. Physics experiments were performed on the SM-1 core at 12.1 Mw yr of energy release. The temperature coefficient was measured as -3.6¢/°F at 440°F. The reactivity value of equilibrium xenon was determined as 3.02 dollars; peak xenon was determined as 4.47 dollars. (W.L.H.)

19967 APAE-Memo-243

Alco Products, Inc., Schenectady, N. Y. SM-2—REACTOR CORE AND VESSEL MONTHLY REPORT [FOR] DECEMBER 15, 1959 TO FEBRUARY 5, 1960. Feb. 19, 1960. 58p. Contract AT(30-3)-326. OTS.

The effect of increasing the width of the fuel matrix upon side plate peaking was calculated. A modification of the thermal stress equation for fuel elements was developed and is being applied to SM-2 and various test elements. Calculations on the stationary fuel element indicate flow forces are great enough to keep fuel elements against the top doors at all times. A brief thermal, nuclear, and hydraulic survey was completed, and the fuel plate dimensions were finalized for the SM-2 test in the WTR. The design adaptation of an SM-2 element for test in the SM-1 was completed. (For preceding period see APAE-Memo-235.) (W.L.H.)

19968 APAE-Memo-251

Alco Products, Inc., Schenectady, N. Y. SM-1—RESEARCH AND DEVELOPMENT QUARTERLY REPORT [FOR] OCTOBER 1 TO DECEMBER 31, 1959. J. O. Brondel, W. S. Brown, O. W. Childs, E. F. Clancy, C. H. Harvey, R. A. Hasse, R. E. May, J. H. Morrison, S. S. Rosen, W. E. Schleicher, R. Stein, D. C. Tubbs, and

G. J. Vodapive—C. H. Obrist, comp. Apr. 8, 1960. 91p. Contract AT(30-3)-326. OTS.

Three incidents of high chloride content in the secondary system occurred. These were caused separately by a plugged evaporator blowdown line, improper evaporator operation, and defective commercial sodium sulfite. A review of previous study efforts to establish criteria for evaluating all plant controls and instrumentation was completed. The task activity continued in the direction of the blocked channel method of instrumenting fuel plates. Tests were run for core physics measurements. Test procedures for gamma and neutron flux measurements in the primary shield and gamma and neutron flux measurements in the instrument well were revised. (For preceding period see APAE-Memo-237.) (W.L.H.)

19969 CF-57-6-120

Oak Ridge National Lab., Tenn.

PERFORMANCE OF HRT CHARCOAL BEDS. Herman O. Weeren and W. J. Lee. June 4, 1957. 21p. Contract [W-7405-eng-26]. OTS.

The expected performance of the HRT carbon beds was calculated for various reactor operating conditions. The calculations indicate that the flow rate of sweep gas will have to be limited to prevent excessive activity discharge. Data on activity discharge are included. (J.R.D.)

19970 CF-59-1-13(Rev.)

Oak Ridge National Lab., Tenn.

FUEL CYCLE COSTS IN A GRAPHITE MODERATED SLIGHTLY ENRICHED FUSED SALT REACTOR. C. E. Guthrie. Feb. 24, 1959. 7p. OTS.

A fuel cycle economic study was made for a 315 mwe graphite moderated slightly enriched molten salt fueled reactor. Fuel cycle costs in the order of 3.3 mils/kwh were calculated for the throw-away cycle. Recovery of the uranium and plutonium at the end of the cycle reduces the cycle costs to ~1.6 mils/kwh. Changes in the waste storage and reprocessing costs have a relatively minor effect on fuel cycle costs. (auth)

19971 CF-59-12-40

Oak Ridge National Lab., Tenn.

ECONOMIC EFFECTS OF GAS-COOLED REACTOR PARAMETERS. Alfred M. Perry. Dec. 9, 1959. 52p. OTS.

The economic effects of varying key reactor design parameters are examined for the case of a graphite-moderated helium-cooled reactor with stainless-steel-clad UO_2 fuel elements. It is shown that for this system power costs tend to level off with power density above about 10 kw/liter. Other variables studied are the number of fuel rods per fuel cluster, the fuel volume fraction, fuel inventory charge, and the pressure vessel wall thickness. (auth)

19972 CF-60-5-18

Oak Ridge National Lab., Tenn.

EVENTS PRECEDING THE LARGE POWER EXCURSION ON NOVEMBER 2, 1959. P. N. Haubenreich. May 18, 1960. 7p. Contract W-7405-eng-26. OTS.

During the Homogeneous Reactor Test Run 21 (the reactor was operating at 1400 psig, 260°C, and 5 Mw) there were indications of abnormal fuel behavior which were climaxed by an unusual reactivity disturbance in which the power reached 22 Mw. Events preceding the excursion are described, and speculations on the cause of such a large power increase are presented. (C.J.G.)

19973 GA-1099

General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.

MARITIME GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1959. 197p. Contract AT(04-3)-187. OTS.

Reactor Development: A code is described which is being developed for the IBM-704 in order to incorporate the effects of actual three-dimensional flux shapes. The IBM-704 code "Peg," developed for the determination of the temperature distribution in the semihomogeneous fuel element, was completed. Assembly of the air-flow test stand was completed, and the testing of a mockup 13-rod fuel element bundle was begun. A preliminary experiment was designed to determine whether it is possible to use water as an emergency coolant in place of an inert gas. The design requirements for a high-pressure, high-temperature helium loop for fuel assembly thermal testing were established. Experiments indicated that a heat flux of 110,000 Btu/hr-ft² can be expected at the surface of the 0.5-in.-diam. pellet. Attempts were made to devise a method of predicting the thermal conductivity of fibrous insulation under reactor conditions. The preliminary design of the pressure vessel was developed. Ten concepts of core support structures were evaluated. Studies were conducted to determine the required thickness and weight of internal biological shielding material. The design of fuel reloading equipment was continued. Fluid Systems and Plant Arrangement: Investigation of reactor heat dump showed the necessity of an air-cooled helium located outside the containment vessel. An experimental program for a four-phase heat-exchanger test loop was laid out and started. Fifteen preliminary valve designs are presented. An experiment to verify the performance of the concentric-duct heat barrier was developed. A number of possible steam generator and jet pump combinations were investigated. Revision of the system transient equations was continued. Engineering for the main coolant system is discussed. Experimental work was continued to establish steady state impurity tolerances. Various methods of purifying helium were studied. A revised load analysis for the a-c power distribution system was completed. The arrangement of the main machinery compartment was analyzed from the points of view of pipe stress and pressure drop. A pressure-drop analysis was completed for the entire main coolant system. Design of primary and secondary shielding for the prototype plant was continued. Rotating Machinery: Studies of the low-pressure turbine were continued. Casing studies indicated that horizontal joints will be satisfactory in most sections of the machine from the standpoints of tightness, strength, and total length of joint. The development of efficient bearings, seals, lubricating oils, and associated systems for application to the prototype gas turbine is discussed. The part-load performance characteristics for the plant arrangement were generated using a digital computer program. Reactor Physics: Based on the established design parameters, a semihomogeneous graphite core was developed to be equivalent to the present preliminary design heterogeneous core. Initial calculations were made to investigate the potential gains in performance from the use of BeO moderator in future maritime reactors. Estimates are being made of the weight of the shielding cask for fuel element removal for both the heterogeneous and semihomogeneous designs. Calculations for the critical assembly were made to determine the magnitude of the expected shutdown coefficient and to decide on an optimum loading pattern for fuel and poison in the core, independent of actual concentrations, which would yield the maximum shutdown coefficient and minimum energy release following an accidental excursion. The final loading configuration chosen is shown schematically. In

connection with the critical experiment safeguards report, dose rates from the operating and shutdown assembly were calculated and are given. **Materials Development:** Investigations concerning the development of fabrication techniques for use in the production of fuel-containing bodies from the materials UO_2 , UC, and UC_2 were pursued. The ternary system Al-U-O was studied. Release of Xe^{133} from samples of sintered UO_2 and from specimens of fused UO_2 was studied. The results of post-irradiation measurements on the first MGCR fuel capsule are given. Two experiments to determine the influence of precipitated C on the ductility of Monel and "A" nickel are discussed. Experiments were continued on the effect of coolant and impurities in the coolant on materials, and further data on the effect of impurities such as CO, on metals are given. Materials investigation and testing are being conducted to ensure proper selection and handling of nonreactor structural alloys, and the selection of safe design stresses. An experiment to determine whether or not helium penetrates through the walls of $1\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo steel piping was conducted. Tests to study the irradiation effects on coolant and impurities were made and data compiled. (For preceding period see GA-1030.) (W.D.M.)

19974 GAI-1499

Gilbert Associates, Inc. Nuclear Energy Dept., Reading, Penna.

GENERAL DESIGN CRITERIA FOR USAF NUCLEAR POWER PLANT APPLICATIONS. Final Engineering Report. R. E. Frick, E. R. Hottenstein, S. D. Goodman, R. M. Bredin, T. E. McGrath, J. B. Frank, W. R. Emes, P. E. Witman, P. J. Sockel, and J. H. Russell. June 1959. 552p. Project 6185. Contract AF30(602)-1923. (RADC-TR-59-132; AD-225792).

Design and selection policies to be employed with regard to military applications of power reactors were completed. Data were developed for a range of plant sizes to serve firm loads from 500 to 70,000 kw. based on light water type reactors. Cost estimates and logistical studies were developed for a US site and for an average remote Arctic site. It is shown that nuclear power plants are economically and/or logistically attractive for supplying military loads at remote sites. Recommendations are made relative to the selection of base load units and backup facilities for various types of load requirements for each plant size from 500 to 70,000 kw. Thermal cycles are analyzed, conceptual designs developed, construction and operating costs estimated, personnel and logistical requirements evaluated, construction schedules estimated, and operating performance discussed. Reactor concepts are reviewed that are likely to emerge from the research and development stages within the next ten years. (auth)

19975 IDO-28543

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM MONTHLY PROGRESS REPORT FOR JULY 1959. Aug. 31, 1959. 53p. Contract AT(10-1)-880. OTS.

Construction is 98% complete on GCRE-I; preparation of operating procedures was continued. Eighty production fuel elements and four instrumental fuel elements were completed for initial core loading. Fuel plates containing spherical UO_2 (enriched) were produced to compare the effect of substituting commercial-grade UO_2 for Geneva type, hydrothermal-grade UO_2 used in previous plates. In the 1B fuel element program emphasis was placed on analyses of heat transfer, effects of burnable poisons, gas corrosion tests of cladding materials, creep tests, and tube burst tests leading to a pin-type core for GCRE. Out-of-pile loop testing was resumed on the 1B fuel element. Design and

fabrication was completed on capsules for irradiation of stainless steel- UO_2 and stainless steel-UN dispersion specimens and for solid UO_2 pin-type specimens. An in-pile loop for testing prototype gas-cooled reactor fuel elements in ETR was designed and the BRR loop modified. Irradiation of a 1B-1 α T fuel element was started and 1B-1 ϕ T flux runs were completed. Irradiation of the Gas Cooled Reactor Experiment II-1C capsule was scheduled. A II-2C capsule was designed to use three independent sub-capsules in the final design, one above the other. A nuclear mock-up of this capsule was fabricated, and flux perturbation measurements were obtained. The complete reference gas flow system was designed and checked out. The thermal cycle loop test section vessel was completed and loop fabrication begun. Welding studies continued with emphasis placed on axial seam welds for fuel cans. At ML-1, fabrication was initiated on mockups to be used in special loading tests. The reactor package was re-designed to conform to the 15-ton-weight requirement and studies were made of the feasibility of performing a shielding experiment for the ML-1 to reduce uncertainty in the shutdown radiation calculation. The turbine-compressor set development program, involving parallel development of two different concepts and fabrication of two units to each design, was completed and presented for approval. Core section and pre-cooler material samples were tested. Cycle analysis was performed on the GTIE system to determine state points for the "as built" plant for closed cycle, open cycle, and startup conditions. (M.C.G.)

19976 IDO-28551

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM MONTHLY PROGRESS REPORT FOR JANUARY 1960. Feb. 29, 1960. 52p. Contract AT(10-1)-880. OTS.

The Army Gas Cooled Reactor Systems Program includes the Gas Cooled Experiments I and II, the ML-1, and the Gas Turbine Test Facility. The design criteria, testing programs, data evaluation, and fabrication programs relating to these projects are covered. Fuel element development and fabrication, materials development, experimental heat transfer, reactor instrumentation, reactor design and development, and nuclear experiments are considered. Work on GCRE-I is briefly summarized. Systems analysis, neutronics, and materials development in the GCRE-II project are reported. Developments in the ML-1 program are discussed in terms of reactor engineering, power conversion equipment, instrumentation and control, and auxiliaries. Fuel element development for ML-1 is reported in some detail. (For preceding period see IDO-28549.) (W.D.M.)

19977 IDO-28553

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM MONTHLY PROGRESS REPORT FOR FEBRUARY 1960. Mar. 31, 1960. 74p. Contract AT(10-1)-880. OTS.

19978 MSAR-60-81

MSA Research Corp., Callery, Penna.
BLOWDOWN WITH VARYING LENGTH ORIFICES. Technical Report 74. G. E. Kennedy and V. K. Heckel. June 28, 1960. 19p. Contract NObs-77023.

A test was conducted to determine if flashing flow occurs during rapid blowdown through orifices of various lengths. The data are necessary for calculating the rate of blowdown, and will be used in evaluating the design of the D1G/D2G reactor compartment blow off ducts. Five runs were made using $1\frac{1}{2}$ in. diameter orifices with a length of either 12, $1\frac{1}{2}$, or $\frac{1}{2}$ in. Flashing flow occurred during blowdown in all five runs. An analysis of the data is being

done by KAPL and is to be reported by them at a later date. (auth)

19979 NAA-SR-Memo-2077

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

STRAIN GAGE INSTALLATION ON MAIN SECONDARY SODIUM SYSTEM OF SRE. L. P. Inglis. Aug. 27, 1957. 20p. OTS.

The installation and performance of strain gages on the main secondary Na system of the SRE are discussed. The effects of temperature dependence of gage readings below the fusing point of the ceramic paste bonding cement and wet insulation of the leads resulted in considerable error in the readings. Operation of the gage at a temperature above the cement fusing point indicated the true strain to a fair degree of accuracy. (C.J.G.)

19980 NAA-SR-Memo-2207

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

AN ELECTRONIC CIRCUIT DESIGN FOR PROVIDING AN INDICATION WHEN THE MARK II SAFETY RODS ARE RELEASED FROM THE HOLDING MAGNET. R. J. Hall. Oct. 21, 1957. 5p. OTS.

19981 NAA-SR-Memo-2578

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SRE EXPERIMENTAL SCRAM DATA—NOVEMBER 20, 1957. K. W. Foster. Mar. 13, 1958. 17p. OTS.

A one-rod scram test was conducted at the SRE while operating at 4 Mw(th) and a temperature gradient of 125°F. The scram was initiated by removing a relay in the scram circuit for low sodium return temperature from the steam generator. Graphs are presented showing the sodium flows and temperatures prior to and immediately following the shutdown operation and the fuel channel sodium exit temperatures ten minutes after scram. (C.J.G.)

19982 NAA-SR-Memo-2711

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A BLACKNESS MEASUREMENT OF AN S.R.E. FUEL CLUSTER. J. W. Zink and W. A. Horning. May 16, 1958. 9p. OTS.

The blackness of a fuel element of a Sodium Reactor Experiment fuel cluster was calculated using a critical equation as developed by small source theory and based on two group calculations. The two values of calculated and experimentally determined blackness were found to agree within the probable error of the two values. (C.J.G.)

19983 NAA-SR-Memo-2930

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

CASK INDEXING USING CLOSED CIRCUIT TELEVISION. M. L. Peelgren. Aug. 13, 1958. 5p. OTS.

The successful indexing of the fuel handling cask by means of closed circuit television for the Hallam Power Reactor was demonstrated. (C.J.G.)

19984 NAA-SR-Memo-3105

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SRE NITROGEN GALLERY SEAL. R. P. Nebiker. Aug. 27, 1958. 7p. OTS.

A description of the SRE nitrogen gallery is presented. The effectiveness of the gallery seal is evaluated. (auth)

19985 NAA-SR-Memo-3128

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

CONVERTING DATA FROM THE WATER TEST LOOP TO SODIUM. R. D. Welsh. Oct. 7, 1958. 9p. OTS.

An investigation was conducted to provide a simple method for converting data taken on the water test loop to sodium flow rate in pounds per second and pressure drop in psi. A diagram showing pressure tap locations is included along with results of calculations for flow and pressure drop at various locations. (J.R.D.)

19986 NAA-SR-Memo-3131

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

NEUTRON AND GAMMA FLUX SURVEY OF THE SRE INSTRUMENT THIMBLES. H. F. Donohue. Oct. 8, 1958. 14p. OTS.

An investigation was conducted to determine the gamma flux in the instrument thimbles and the simultaneous neutron-gamma flux decay after shutdown. The data verified the nuclear instrument accuracy and were used to ascertain the effects of shutdown-gamma on the sensitivity of the neutron detectors. (J.R.D.)

19987 NAA-SR-Memo-3134

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DESIGN AND FABRICATION OF SRE CORE HEATER PROTECTIVE TUBES. R. L. Shelby. Oct. 8, 1958. 6p. OTS.

Calculations are presented upon which recommendations were made to place long protective tubes around the SRE core heaters. Calrod units were used and arranged in such a way that a space between the unit and tube was effected. Descriptions of equipment and calculations are included. (J.R.D.)

19988 NAA-SR-Memo-3142

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

REACTIVITY OF MC-2-2 IN THE SRE. R. W. Woodruff. Oct. 30, 1958. 5p. OTS.

Results of an experiment are given in which the reactivity of a standard SRE fuel cluster and an experimental cluster were compared. The reactivity worth of the experimental cluster was then calculated. Calculations and data are included. (J.R.D.)

19989 NAA-SR-Memo-3920

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FABRICATION AND INSPECTION TECHNIQUES FOR THE SRE ALTERNATE CALANDRIA CORE. C. L. Peckinpaugh. May 25, 1959. 18p. OTS.

The development of fabrication and inspection techniques for the SRE alternate calandria core is described. Aspects of welding, distortion, alignment, stress relieving, and inspection are discussed. (J.R.D.)

19990 NAA-SR-Memo-3933

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

WORTH OF ENRICHED URANIUM FUEL AFTER IRRADIATION IN THE SRE. R. W. Woodruff. May 27, 1959. 3p. OTS.

The difference in reactivity between virgin and irradiated enriched uranium fuel was measured for various average cluster powers and exposures in the SRE. Results are presented graphically. (J.R.D.)

19991 NAA-SR-Memo-3934

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

RADIAL STATISTICAL WEIGHT FOR THE SRE. R. W. Woodruff. May 27, 1959. 4p. OTS.

The change in reactivity, with the SRE at low power, caused by replacing a fuel cluster with a dummy element was measured as a function of radial position. The reactor was loaded with 43 clusters containing either enriched uranium or experimental fuel. The measured difference is proportional to the radial statistical weight. The results of both loadings are presented graphically. (J.R.D.)

19992 NAA-SR-Memo-4310

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

CALCULATION OF THE TEMPERATURE DISTRIBUTION IN THE HNPf MODERATOR CAN. W. H. East. Oct. 27, 1959. 6p. OTS.

An investigation was conducted to find the numerical solution of steady-state temperature distribution in the Hallam Power Facility moderator can for various heat removal rates along the flat. An evaluation of the investigation results is included. (J.R.D.)

19993 NAA-SR-Memo-4656

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PERFORMANCE REQUIREMENTS AND DYNAMIC RESPONSE OF PIQUA OMR STEAM PRESSURE CONTROL SUBSYSTEM. D. Mason. Nov. 20, 1959. 96p. OTS.

19994 NAA-SR-Memo-4698

Atoms International. North American Aviation, Inc., Canoga Park, Calif.

VIBRATIONAL CHARACTERISTICS OF AN HNPf 19-ROD 5.0 SQUARE INCH FUEL ELEMENT MOCKUP. J. A. Hagel. Dec. 2, 1959. 17p. OTS.

Tests to determine the stresses in 19-rod U-Mo Hallam fuel elements due to hydraulically induced vibrations were conducted. No significant vibrations existed in weight flow rates equivalent to those found in the Hallam fuel channels. (J.R.D.)

19995 NAA-SR-Memo-4776

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PRESSURE DROP MEASUREMENTS ACROSS A MOCKUP OF AN SRE 7-ROD FUEL ELEMENT WITH AN ORIFICE PLATE AT THE TOP. R. J. Begley. Dec. 23, 1959. 12p. OTS.

Pressure-drop measurements were made across a simulated SRE process tube containing a mockup of a standard 7-rod fuel element with a 6-hole orifice assembly located at the top. Data were obtained using water as a test fluid and converted to sodium at 750°F. (C.J.G.)

19996 NAA-SR-5018

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DISPERSION FUELS FOR ADVANCED ORGANIC MODERATOR REACTOR. J. Kroehler, Jr. June 30, 1960. 44p. Contract AT-11-1-GEN-8. OTS.

An evaluation of previous test results on dispersion fuel element materials indicates that Al, Be, Mg, Zr, and graphite when employed as matrices and blended into combinations containing 25 to 35 vol. % of the fissile dispersed phase UAl_2 , UC, Un, UO_2 , or U_3Si_2 exhibit the most promise for advanced organic moderated reactor concepts. Dispersed particle size should be kept large (100 to 200 microns) compared to matrix particle size to confine fission product damage in the dispersant and maintain a continuous matrix. Powder metallurgy methods of fabrica-

tion were generally found superior to the melt and cast method. Poor corrosion resistance of Mg and Zr in the organic coolant, low elevated temperature strength of Al and Mg, and the brittleness and poor fission product retention of graphite are discussed. The bonding and diffusion problems associated with several matrix-cladding systems are described. Radiation damage is considered. Various dispersion fuel concepts are proposed. (auth)

19997 NAA-SR-Memo-5065

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

POWER CALIBRATION OF GRAPHITE CRITICAL ASSEMBLY. C. H. Skeen. Mar. 21, 1960. 5p. OTS.

The absolute power of the ASGR graphite critical facility was measured by use of a gold foil activation technique. (C.J.G.)

19998 NAA-SR-Memo-5085

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

CONTROL ROD TEST FURNACE CONTROL SYSTEM. J. W. Crowe. Mar. 18, 1960. 19p. OTS.

A description and operation of the control rod test-furnace control system for the Hallam Power Reactor are presented. The controller establishes the desired temperature profile along the length of the furnace. This profile is set to simulate the profile which rods will experience in the reactors. (C.J.G.)

19999 NAA-SR-5119

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FUEL ELEMENT DEVELOPMENT FOR PIQUA OMR. M. H. Binstock. June 30, 1960. 52p. Contract AT-11-1-GEN-8. OTS.

Development of fuel elements for the Organic Moderated Reactor at Piqua, Ohio, (Piqua OMR) is described. These elements consist of 1.94% enriched U-3.5 Mo-0.1 Al alloy, nickel-bonded to extended surface Type 1100 aluminum cladding, in the form of two concentric circular cylinders. The development program for such elements included evaluation of fuel alloys having compositions near U-3.5 Mo (with small ternary additions of Al and Si), fuel cylinder casting, preparation of helically-finned extruded cladding, application of the nickel bond layer and bonding by hot pneumatic pressing, and establishing procedures for fuel mechanical assembly. (auth)

20000 NAA-SR-Memo-5124

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

HYDRAULIC TESTS OF THE 5-ROD AND DUMMY SRE FUEL ELEMENTS. R. J. Begley. Apr. 28, 1960. 14p. OTS.

Pressure-drop measurements were made across a mockup of a 5-rod dummy SRE fuel element in a test section which simulated an SRE fuel channel. Data were obtained using water as a test fluid and were converted to sodium at 750°F which is the arithmetical mean of the process-tube entrance and exit temperatures. (J.R.D.)

20001 NAA-SR-Memo-5146

Atoms International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ANALOG COMPUTER STUDY OF THE 255 Mw ASGR CORE KINETICS. H. H. Cappel. Mar. 26, 1960. 38p. OTS.

An investigation was conducted to determine the kinetic behavior of the 255 Mw ASG reactor power and temperatures for various step and ramp reactivity excursions as well as for loss of coolant flow accidents during various

initial steady state power levels. In general it was found that reactivity excursions of prompt critical or larger, with the reactor operating at 50% of full power initially, produce the worst coolant exit temperature conditions. Calculations on excursions are presented graphically. (J.R.D.)

20002 NAA-SR-Memo-5270

Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.

REACTIVITY WORTH OF CONTROL RODS IN THE PIQUA OMR CRITICAL ASSEMBLY. K. Einfeld. May 10, 1960. 10p. OTS.

An investigation was conducted to determine the reactivity worth of central and eccentric control rods in the Piqua OMR critical assembly. The ratios of the control rod worths are compared with theoretical values. (J.R.D.)

20003 NDA-84-14

Nuclear Development Corp. of America, White Plains, N. Y. PRELIMINARY SAFETY ANALYSIS OF THE SODIUM-DEUTERIUM REACTOR (SDR). C. C. Beusman, comp. Mar. 6, 1959. 133p. Contract AT(30-3)-256. OTS.

A preliminary safety evaluation was made of the Sodium-Deuterium Reactor (SDR), a sodium-cooled, D₂O-moderated reactor utilizing a fuel tube and calandria design concept. A study of mechanical equipment malfunction, fluid system failures, and operational accidents revealed that the reactor has sufficient inherent and design safety features to render it safe from major energy release hazards. The successful operation of an integrated sodium-water system in a mockup of the reactor verified the feasibility of the separation of sodium and water under simulated reactor operating conditions. (auth)

20004 NP-8828

Lockheed Nuclear Products, Marietta, Ga.

ESTIMATION OF THICK TARGET NEUTRON SPECTRA PRODUCED BY THE T(d,n)He⁴ REACTION. E. E. Dungan and F. T. Bly. June 1960. 16p. (NR-90).

Neutron spectra curves are presented for the T(d,n)He⁴ reaction in zirconium, titanium, and lithium tritides and in tritium oxide. Deuteron energies up to 0.6 Mev are treated. (auth)

20005 NP-8885

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

ALLOWABLE POWERPLANT WEIGHTS FOR TYPICAL NUCLEAR ROCKET APPLICATIONS. P. G. Johnson, J. W. Miser, and R. L. Smith. 1959. 38p.

Presented at Mtg. of NASA Research Advisory Committee on Nuclear Energy Processes, Nov. 1959.

Results of a study to determine allowable nuclear rocket powerplant weight in terms of performance, vehicle parameters, and mission type are presented. These results may be useful in comparison of the many reactor and propulsion-system concepts which should be investigated during early phases of nuclear-rocket development. Charts and curves on weights and payloads in typical applications for estimating desirable power levels and operating conditions are included. (J.R.D.)

20006 TID-6077

Savannah River Operations Office, AEC.

HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT [FOR] MAY 1960. 15p. (SRO-33). OTS.

Nineteen-rod clusters of 1-in. natural U-metal rods were investigated in the PDP experimental program, and nineteen-rod clusters of UO₂ rods were studied in PSE experiments. Testing of the high-pressure two-phase flow

loop was continued. The hydraulic pusher mechanism for swaging operations and the vibratory compaction unit were successfully operated. At the CMX area, tests on the mock-up of a nineteen-rod fuel bundle were begun and valve leakage tests completed. Functional and hydrostatic testing was completed on the Task X loop. Severe vibrations caused by boiling in highly subcooled flow were reported in the boiling water channels. Preliminary experiments on PLATR were continued. Seal leakage tests were completed on the EBWR. Plant arrangement and cycle comparison studies were continued with emphasis on reduction of plant costs. Construction of the 400-area loop, to test the HWCTR bayonet test loop conditions, was completed and testing begun. The base ring for the steel containment shell was fitted, welded, and stress relieved. All work on the concrete shell was completed. Reactor design was changed in anticipation of a shift to beryllium-clad fuel elements after studies in France and England. However, measurements of a beryllium capsule after irradiation at ORNL indicated a serious density change. Testing of stainless steel and Zr-Cu-Mo alloys was continued. Investigation of transpiration cooling indicated that it would be impractical. Work continued on HYDNA, a code for the degree of hydraulic stability. Studies revealed that a 1-ft reduction in the diameter of the reference design tank would save 10,000 lbs of D₂O. CVTR Phase I-A tests revealed that small holes in the baffles increased appreciably the total heat loss of the system. The Conoseal refueling port test fitting was tested for reproducibility of sealing. Test-fitting for the upper in-pile Zircaloy to 410 stainless steel transition joint was thermally cycled forty-six times under normal operating conditions. Pressure drop data were reduced and studied, and the hydrodynamic design of the streaming plug was re-evaluated with the aim of reducing pressure drop. A test was initiated to determine the effect of helium saturated with H₂O vapor on the corrosion resistance of Ag-In-Cd, Ag-In-Cd-Sn, and boronated stainless steel absorber materials. Zirconium phosphates and oxides were evaluated for ion capacity. Evaluation of the applicability of the SURGE 4 Code to CVTR was made. Studies indicated that a modified version of the refueling machine was feasible. The pressures at which local boiling would occur during step reductions in power were determined. (M.C.G.)

20007 TID-6092

Duquesne Light Co., Shippingport, Penna.

MONTHLY OPERATING REPORT [FOR] OCTOBER 1958. George Rifendifer. 37p. Contract AT(11-1)-292. OTS.

20008 TID-6097

Duquesne Light Co., Shippingport, Penna.

MONTHLY OPERATING REPORT [FOR] MAY 1959. 37p. Contract AT(11-1)-292. OTS.

20009 TID-6098

Duquesne Light Co., Shippingport, Penna.

MONTHLY OPERATING REPORT [FOR] JUNE 1959. 39p. Contract AT(11-1)-292. OTS.

20010 TID-6099

Duquesne Light Co., Shippingport, Penna.

MONTHLY OPERATING REPORT [FOR] OCTOBER 1959. 33p. Contract AT(11-1)-292. OTS.

20011 TID-8518(Bk. 5)

Atomic Energy Commission, Washington, D. C. and General Nuclear Engineering Corp., Dunedin, Fla.

CIVILIAN POWER REACTOR PROGRAM. PART III. BOOK 5. STATUS REPORT ON BOILING WATER REACTORS TECHNOLOGY AS OF 1959. 1960. 87p. GPO.

An evaluation of the technological and economic status of

boiling water reactors as of 1959 is given for power plants in the 25 to 325 Mwe range. Reactors already in operation have demonstrated safety of operation, stability at high power densities with large reactivities in steam voids, and lowered capital costs from simplification of plant design. The physics of reactors is known sufficiently to permit conservative extrapolation to large power reactor designs. Heat transfer and fluid flow characteristics are described, and the following topics are discussed: reactor safety, reactor stability, coolant chemistry, components and auxiliary systems, containment, and fuel failure detection. Both experimental and power demonstration (domestic and foreign) reactors are treated. (D.L.C.)

20012 TID-8518(Bk. 7)

Atomic Energy Commission, Washington, D. C. and
 Atomics International. Div. of North American Aviation,
 Inc., Canoga Park, Calif.

CIVILIAN POWER REACTOR PROGRAM. PART III. BOOK 7. STATUS REPORT ON ORGANIC-COOLED POWER REACTORS AS OF 1959. 1960. 82p. GPO.

A survey is given of the 1959 status of technology on organic-cooled reactors, the following topics being discussed: work completed and underway, operational experience gained from OMRE, several typical organic-cooled reactor power plant designs, and the economics of such plants. The following aspects of technology are treated: physics of organic-moderated reactors, fuel elements and their properties, heat transfer and fluid flow, coolant chemistry, safety, components, and auxiliary systems. At present, the only operating organic-cooled reactor is the OMRE, but one is under construction at the Piqua plant site which is rated at 11.4 Mwe and scheduled to start operation in late 1961. (D.L.C.)

20013 TID-8523

Division of Reactor Development, AEC; Argonne National
 Lab., Ill. and Atomic Power Development Associates,
 Inc., Detroit.

FAST BREEDER REACTOR PROGRAM. Jan. 1960. 13p. OTS.

The fast breeder power reactor program is discussed relative to capital costs, thermal efficiency, operating and maintenance experience, specific power, material utilization and cycle flexibility, nuclear considerations, burnup, fuel fabrication, and fuel losses. (W.D.M.)

20014 TID-8525

Gibbs and Hill, Inc., New York.

SMALL SIZE PRESSURIZED WATER REACTOR SPECIFICATIONS. Nov. 16, 1959. 78p. OTS.

Specifications are presented for the design, fabrication, testing, and supply of certain major components for a nuclear steam generating system of the pressurized light water type. Dry and saturated steam will be generated at a rate of 235,000 lbs/hr at a pressure of 500 psig and will be used to generate electrical power. (W.L.H.)

20015 WCAP-563

Westinghouse Electric Corp. Commercial Atomic Power
 [Activity], Pittsburgh.

A PROCEDURE FOR DETERMINING PRESSURIZER DESIGN PARAMETERS. J. M. Gallagher, Jr. June 1957. 64p.

A simplified representation of a pressurizer system applicable to solution on a general purpose analog computer was developed from a combination of the first and second laws of thermodynamics. The primary objective of this representation was to provide performance data for the determination of pressurizer design parameters that limited the maximum pressure rise to a pre-selected value. From

this performance data a graphical correlation was obtained that relates, for a predetermined allowable pressure rise, maximum positive surge volume and surge rate to surge spray rate, surge spray temperature, set point pressure and initial steam volume. An analysis based on linearized relationships derived from the steam tables was developed for the purpose of extending the analog computer results. The results of this analysis are compared to computer data and show very good agreement. As a secondary objective the analog computer representation was used to determine the complete transient behavior of the pressurizer for positive surge resulting from a bounded ramp input in surge volume. (auth)

20016

THE MARINE BOILING WATER REACTOR. D. A. Smith
 (Nuclear Power Group, Kuntsford, Ches., Eng.). Brit.
 Power Eng. 1, No. 2, 26-33(1960) July.

A design study is presented for a marine boiling water reactor for a 20,000-SHP, 65,000-ton tanker. The advantages of a boiling water reactor over gas-cooled reactors are pointed out. The system described is of the natural circulation and direct cycle type and is rated at 60 Mwh. Among the discussed topics are the parameters, load control system, reactor stability, fuel element failure, and safety aspects. (D.L.C.)

20017

PRESSURE SUPPRESSION CONTAINMENT FOR NUCLEAR POWER PLANTS. PART II. DESIGN CONSIDERATIONS OF SYSTEMS. C. C. Whelchel (Pacific Gas and Electric Co., San Francisco) and C. H. Robbins (General Electric Co., San Jose, Calif.). Nuclear Energy, 321-2 (1960) July.

Considerations are given for the design of a pressure suppression system. The dry well must not break in the event of a primary system break; threats to dry well integrity are blast, dynamic force, missiles, and static pressure, of which the last three are most important. The effects of the area of the vent into the pool are considered. The water volume in the pool should be large enough to absorb energy from the reactor water and not go above 120 to 130°F, in which case pressure waves will be generated. It is concluded that pressure suppression offers important safety advantages and may be less expensive than dry capsule-type containment for boiling water or pressurized water reactors. A drawing is given of a pressure suppression system designed for Humboldt Reactor No. 3. (D.L.C.)

20018

BREEDING POTENTIAL OF THERMAL REACTORS.

J. F. Kaufmann and E. D. Jordan (U. S. Atomic Energy Commission, Washington, D. C. and Catholic Univ., Washington, D. C.). Nuclear Sci. and Eng. 8, 85-7(1960) July.

The depletion of U. S. uranium reserves, the need for breeder reactors, and the breeding potentials of some reactors are treated with special reference to certain statements made recently on those topics. The limitation of economically recoverable uranium reserves to those which can be recovered at less than twice the present cost is merely arbitrary; if nuclear technology can extend utilization of total uranium available from the present 0.5% to 5%, the price could be increased by a factor of ten. Data on U. S. uranium resources from an AEC report (TID-8201) are used to prepare two tables of the cumulative reserve lifetimes; the first is based on the unrealistic assumptions that the total electrical generating capacity of U. S. is completely nuclear and that the reactor conversion ratio is zero (uranium recycle), while the second is based on

realistic assumptions, e.g., conversion ratio = 2/3. The two tables are compared and it is stated that statements implying a very rapid depletion of U. S. uranium reserves can be highly misleading unless well qualified. Also, one breeder system cannot be said to be more economical than another since reactor economics cannot be known exactly for quite a time. (D.L.C.)

20019

REDUCING RADIOACTIVITY BUILDUP IN PWR'S.

William S. Brown and Carl A. Bergmann (Alco Products, Inc., Schenectady, N. Y.). *Nucleonics* 18, No. 7, 60-63 (1960) July.

The buildup of radioactivity in pressurized water reactors (PWR) is discussed in general and measurements are reported for the SM-1 reactor. The major factors in the buildup process are corrosion of primary system materials and corrosion product deposition. The SM-1 differs from other PWR in that its entire primary system, including fuel cladding, consists of type 304 stainless steel, and thus the major long-lived γ active nuclides are Cr^{51} , Mn^{54} , Co^{58} , Fe^{59} , and Co^{60} . After 17 months of SM-1 operation, a film of 50 to 83 mg/dm² was deposited on primary system surfaces, and the radiation level outside of the piping due to this film was 60 to 70 mr/hr 24 hrs after shutdown. After 2 yrs of operation, Co^{60} and Co^{58} accounted for ~80% of the long-lived γ activity. A buildup mechanism in which the major source of Co^{60} is assumed to be the release of activated corrosion products in the in-flux areas agrees well with the data. On the other hand, for reactors having a small proportion of in-core stainless steel surfaces, e.g., naval reactors, the measured Co^{60} levels is best accounted for by assuming them to be corrosion products transported to the in-flux areas. The limitations of the activity buildup calculations are discussed together with the effects of buildup on SM-1 operation. Several possible means of buildup reduction are given, e.g., impurity control, elimination of crud traps, and coolant chemistry. (D.L.C.)

20020

PROBLEMS OF ATOMIC POWER. E. P. Anan'ev. *Vestnik Akad. Nauk S.S.S.R.* 30, No. 3, 3-12(1960) Mar. (In Russian)

A comprehensive survey of the state of nuclear power development is given, and prospects for the future are discussed. The importance of breeding is stressed, and the great promise of fast reactors with larger breeding ratios is discussed. Soviet fast reactors are described; the BR-1, an experimental reactor that went critical in 1955; the BR-2, that reached thermal power of 100 kw and was cooled by mercury; the BR-5, that is now operating at thermal power of 5 Mw, fueled with PuO_2 and cooled by liquid sodium at a maximum temperature of 500°C. A fast reactor for power generation will follow the BR-5. Descriptions are given of Soviet boiling water reactors that vaporize water in circular fuel channels. Stable flow of water, water-vapor mixture, and vapor only is obtained through throttling orifices at the entrances to the various fuel channels. The power levels of this reactor design are said to be less limited than those of surface boiling designs. Greater safety is also claimed for the fuel channel boiling design. However, the nuclear advantages of the surface boiling design (water moderated and cooled) over the fuel channel boiling design (graphite moderated) are mentioned. The Ulianovsk reactor is of the surface boiling design. Thus, two boiling water designs are presently under test in the U.S.S.R. (TTT)

20021

General Nuclear Engineering Corp., Dunedin, Fla.
POWER REACTOR TECHNOLOGY. Technical Progress

Review, Vol. 3, No. 3. Walter H. Zinn, ed. 1960. 74p. \$0.55(GPO)(domestic), \$0.70(GPO)(foreign).

General Research and Development. Section one of this volume is devoted to reactor physics and discusses the following subjects: thermal neutron distribution near temperature discontinuities, temperature coefficients of reactivity, measurements related to thermal breeding, power flattening by variation of moderator properties, and analog for three-dimensional reactor. The second section discusses heat transfer and fluid flow. The next three sections report information on containment, fuel cycles, and fuel elements. The sixth section, on control-rod materials, discusses reactivity requirements and control-rod effects, effectiveness of control rod materials, burnup of control-rod materials, boron steel, cadmium and cadmium alloys, hafnium, rare earths, and material costs and applications. The last section describes research on the direct conversion of nuclear energy. **Progress on Specific Reactor Types.** The five sections comprising this part of the volume are devoted to design studies and evaluations, Plutonium Recycle Test Reactor, Homogeneous Reactor Experiment No. 2, boiling-water reactors, and organic-cooled reactors. (W.L.H.)

20022

EPITHERMAL THORIUM POWER-BREEDER REACTOR. (to North American Aviation, Inc.). British Patent 834,617. May 11, 1960.

The design of an epithermal thorium power-breeder reactor is presented. The core of the reactor contains a moderator in an amount to produce an epithermal neutron spectrum. The fuel for the reactor is contained in the moderator, and a liquid metal coolant is used for removing fission heat from the core. The breeder blanket is positioned about the core and contains thorium and a moderator. (W.L.H.)

20023

NUCLEAR REACTOR. Rudolf Schulten. British Patent 834,829. May 11, 1960.

The design of a fluid-fuel gas-cooled reactor is reported. The fuel is in the form of finely divided powder. It is poured into the reaction zone from the top and removed from the bottom with a worm conveyor. The reactor has a graphite reflector and breeding blanket. (W.L.H.)

20024

NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 836,843. June 9, 1960.

The design of a heterogeneous power reactor is presented. The core of the reactor consists of parallel fuel channels in which fuel elements are inserted at one end and withdrawn from the other end. The end closures for the insertion and withdrawal ends of the channels which position the fuel elements within the reactor during operation and release the fuel elements for withdrawal for the discharge operation are shown. Fuel elements are designed for insertion into the channels at one end and withdrawal at the other. (W.L.H.)

20025

BOILING WATER REACTOR. (to U. S. Atomic Energy Commission). British Patent 840,789. July 13, 1960.

The design of a boiling water reactor is presented. An injection nozzle is used with each fuel tube of the reactor to introduce feed water into the tube and to draw into the fuel tube moderator water that surrounds the fuel tube, whereby the power production can be increased and also made variable. The pump for this operation can be small since it only handles the feed water portion of the total water flowing through the fuel tubes. The use of an injection nozzle

for feed water at the bottom of each fuel tube has the additional advantage of causing the moderator water to flow along the exterior of the tube, so that the tendency of steam to be formed outside the fuel tube is minimized and the effectiveness of the moderator water is not reduced. (W.L.H.)

20026

IMPROVEMENTS IN THE UTILISATION OF HEAT FROM NUCLEAR REACTORS. Abraham Rutenberg. British Patent 841,303. July 13, 1960.

A method is described for using a part of the heat which remains contained in the reactor coolant after it passes through the heat exchanger. This is accomplished by introducing a further stage of heat exchangers before the coolant returns to the reactor. This process heat is used for processes other than electrical production. (W.L.H.)

Production Reactors

20027 HW-57016(Rev.1)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ROD AND SHIELD COOLING WATER SUPPLY SYSTEMS. 105-N DESIGN CRITERIA—PROJECT CAI 816. G. E. Wade. Mar. 31, 1960. 11p. OTS.

Design descriptions of control rod cooling water system, thermal and miscellaneous shield cooling system, and primary reactor shield cooling system for Hanford Production Reactor (NPR) are presented. Flow diagrams are included. (J.R.D.)

Research Reactors

20028 AE-10

Aktiebolaget Atomenergi, Stockholm.

EQUIPMENT FOR THERMAL NEUTRON FLUX MEASUREMENTS IN REACTOR R2. E. Johansson, T. Nilsson, and S. Claeson. Apr. 1960. 12p.

Thermal neutron flux measurements in Swedish Reactor (R-2) employ cobalt wires. The loading and removal of the wires are described. A wire scanning device for analysis of the wires is described. (C.J.G.)

20029 ANL-6036

Argonne National Lab., Ill.

OPERATING MANUAL FOR THE ARGONAUT REACTOR. Aug. 1959. 39p. Contract W-31-109-eng-38. OTS.

The manual represents a revision of the second operating manual, including the additional experience gained during the interim period. An attempt is made to coordinate activities properly and insure, as much as it is possible to do so by rules and regulations, the safe and efficient operation of the reactor. (W.D.M.)

20030 CEA-1394

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

DOSIMETRIE EN NEUTRONS RAPIDES DANS LES REACTEURS DE RECHERCHE. (Fast Neutron Dosimetry in Research Reactors). R. Eckert. 1960. 28p.

The measurement of fast neutron fluxes by means of threshold detectors is considered. It is shown first that the cross sections to use for measurements by threshold detectors depend largely on the neutron spectrum, that is, the position in which the measurement is performed. The spectrum is determined by calculation for several positions in the EL2 and EL3 piles. From this can be deduced the cross sections to be used for the measure-

ments carried out in these positions. Possible methods for the experimental determination of the spectrum are indicated. (auth)

20031 CEA-1396

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucleaires, Saclay.

QUELQUES PROBLEMES PARTICULIERS POSES PAR LE FONCTIONNEMENT DES PILES LABORATOIRES.

(Some Particular Problems Posed by Operating Laboratory Reactors). C. Candiotti, R. Mabeix, and R. Uguen. 1960. 31p.

On the basis of six years experience in operating research reactors, first, the difference in utilization between these piles and another similar one is given and, then the corresponding services are outlined. These services pose very particular problems in operating, maintenance, and modifications or additions to the apparatus. (auth)

20032 CF-58-6-13

Oak Ridge National Lab., Tenn.

REVIEW OF THE ORR SHIELD FOR 30-Mw OPERATION. Walter Zobel, E. G. Silver, and T. V. Blosser. June 16, 1958. 21p. Contract [W-7405-eng-26]. OTS.

The proposed shield for the Oak Ridge Research Reactor was reviewed for a reactor power of 30 Mw. It was concluded that the shield is more than adequate for this power providing the shield is augmented at the experimental facilities. (auth)

20033 GA-722

General Atomic Div., General Dynamics Corp., San Diego, Calif.

HAZARDS REPORT FOR TORREY PINES TRIGA REACTOR. May 27, 1959. 38p. OTS.

With this is bound: APPLICATION FOR AMENDMENT TO AEC LICENSE NO. R-38. E. Creutz. Apr. 5, 1960.

A new hazards evaluation of the Torrey Pines TRIGA Reactor, based on one year of operation, was made. Evaluations were made of the degrees of hazard associated with reactor power transients, improper fuel loading procedures, loss of shielding water, radioactive contamination of the shielding water, production of radioactive gases in those regions of the reactor containing air, and routine handling of radioactive materials produced by the reactor. Results showed that the reactor could operate with step reactivity insertions of up to 2 dollars without presenting undue hazard to the health and safety of either the public or operating personnel. A request for authorization to operate the reactor at steady-state power levels up to 1.5 Mw, instead of 250 kw, was made. An analysis indicated that steady-state operation at 1.6 Mw did not constitute an undue hazard to health and safety. (M.C.G.)

20034 NARF-60-2T

Convair, Fort Worth, Tex.

ASTR SOURCE TERMS. L. M. Bostick. Apr. 30, 1960. 65p. Contract AF33(600)-38946. (FZK-9-144).

Source terms (gamma and neutron leakage) for Aircraft Shield Test Reactor (ASTR) Configurations 3, 4, 5, and 15 were calculated by a penetration method which employs moments-method solutions of the Boltzmann transport equation. Both primary and secondary gamma rays were considered. Comparisons are made with direct-beam dose rates measured in the horizontal midplane of the ASTR by the direct-beam-shield technique. The gamma and neutron spectra, calculated at discrete energy levels, are compared with available experimental data. On the average, the calculated total leakage dose rates are within 25% of

those measured. The largest discrepancy is for ASTR Configuration 4 where the calculated neutron leakage is 52% high. It is assumed that the ASTR leakage is symmetrical about the cylindrical axis of the ASTR and may be represented by measurements made in the horizontal midplane. It is shown that the effect of the measured irregularities in the leakage outside the horizontal midplane does not alter the conclusions of the analysis seriously. (auth)

20035 NRL-5483

Naval Research Lab., Washington, D. C.
NEUTRON FLUX MEASUREMENTS FOR MATERIALS IRRADIATION EXPERIMENTS AT ARGONNE NATIONAL LABORATORY, BROOKHAVEN NATIONAL LABORATORY, OAK RIDGE NATIONAL LABORATORY, AND NATIONAL REACTOR TEST STATION. L. E. Steele and J. R. Hawthorne. Mar. 16, 1960. 12p.

In studies of the effects of nuclear radiation on the properties of steel, a continuous effort was made to measure accurately the neutron-flux density and energy spectrum in four research reactors. Such measurement, made with various dosimeter materials, determined which reactor facility provides the desired nuclear environment, and served as necessary parameters in assessing mechanical property changes in irradiated steels. Flux surveys for all reactor experiments were limited to threshold detectors with nuclear and physical characteristics suitable for extended reactor exposure under varying environmental conditions. These monitors, cobalt, cadmium-shielded cobalt, nickel, and sulfur, were utilized in flux measurements for the Argonne National Laboratory CP-5 Reactor, the Brookhaven National Laboratory Graphite Reactor, the National Reactor Test Station Materials Testing Reactor, and the Oak Ridge National Laboratory Low Intensity Test Reactor. The neutron-flux data for high-flux positions in these four research reactors show a high-degree of correlation with changes in materials properties after irradiation. (auth)

20036

THE 50 MW RESEARCH REACTOR SM. S. M. Feinberg, S. T. Konobeevskii, N. A. Dollezal, I. Ya. Emel'yanov, V. A. Tsykanov, Yu. M. Bulkin, A. D. Zhirnov, A. G. Filippov, O. L. Shchipakin, V. P. Perfil'ev, A. G. Samoilov, and V. I. Ageenkov. *Atomnaya Energ.* 8, 493-504 (1960) June. (In Russian)

Descriptions are given of the Research Reactor SM with neutron flux $2.2 \times 10^{15}/\text{cm}^2 \text{ sec}$. The SM was designed for research in nuclear physics and reactor techniques. The reactor operates with intermediate neutrons and has a high maximum neutron flux ratio to the thermal power. The efficiency of the reactor is $4.4 \times 10^{10} \text{ n/cm}^2 \cdot \text{sec} \cdot \text{kw}$. Physics specification and engineering data are included. (R.V.J.)

20037

CRITICALITY OF MTR-TYPE FUEL ELEMENTS.

Robert E. Lightle (Babcock & Wilcox Co., Lynchburg, Va.). *Nucleonics* 18, No. 7, 59 (1960) July.

A graphical method is given for predicting the criticality of water-reflected MTR-type fuel elements to within 4% of the measured value of k_{eff} . The k_{eff} is given by $k_{\text{eff}} = k_{\infty} / (1 + M^2 B^2)$; graphs are given for k_{∞} vs. U^{235} atom density for 15- and 20-mil cladding and for M^2 (migration area) vs. plate thickness. The buckling B^2 is computed from a formula involving the radial reflector savings and the configuration radius. The above method is valid for a solidly constructed core and irregular arrays, but it has not been verified for cores having large water volumes within the core. (D.L.C.)

20038

ONE YEAR WWR-S—REACTOR EXPLOITATION IN POLAND. J. Aleksandrowicz (Inst. of Nuclear Research, Warsaw). *Nukleonika* 5, 1-21 (1960). (In Polish)

Reactor utilization during an exploitation of one year is reviewed. Changes and supplementary equipment are described which make reactor exploitation easier and extends experimental possibilities. Results are given of some measurements connected with physical and technical characteristics of the reactors. (B.O.G.)

20039

MEASUREMENT OF ANGULAR DISTRIBUTION OF SCATTERED NEUTRONS FROM EXPERIMENTAL REACTOR CHANNEL. Tadeusz Rzeszot (Instytut Badań Jądrowych, Warsaw). *Nukleonika* 5, 191-4 (1960). (In Polish)

Angular distributions of scattered neutrons from the first horizontal channel of the EWA reactor were measured at 50 and 200 kw. Measurements were made with a BF₃ proportional counter. (auth)

WASTE DISPOSAL AND PROCESSING

20040 HW-62607

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ZEOLITIC EXTRACTION OF CESIUM FROM AQUEOUS SOLUTIONS. L. L. Ames, Jr. Sept. 30, 1959. 23p. Contract AT(45-1)-1350. OTS.

Several zeolites were examined for their ability to effectively remove Cs from solutions containing large amounts of competing cations. Clinoptilolite satisfactorily removed Cs from these relatively high-salt solutions. This was done over a known range of pH values from 1 to 12 at flow rates of 20 to 200 gal/ft²/hr. (auth)

20041 IDO-14510

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CAPACITY TEST DATA FOR THE ADSORPTION OF VOLATILE RUTHENIUM ON SILICA GEL. D. R. Anderson and D. W. Rhodes. June 17, 1960. 21p. Contract AT(10-1)-205. OTS.

The operation of a fluidized bed calciner to convert acidic, highly radioactive, aqueous aluminum nitrate wastes to solid aluminum oxide is expected to convert as much as 99% of the feed Ru to a volatile species at 400°C and possibly as little as one-tenth of this amount to a volatile species if the calcination temperature is increased to 500°C. The volatile Ru will be carried in the off-gas stream and must be removed before releasing the off-gas to the environs. Laboratory experiments were conducted to study the capacity of silica gel for adsorbing this volatile Ru from calciner off-gas. The most effective adsorption occurred at a temperature just above the dew-point of the off-gas. Use of the same bed of silica gel through four adsorption-desorption cycles resulted in an increasing average decontamination factor for each successive cycle; however, saturation of the silica gel with respect to Ru was not obtained. The inability to achieve saturation of the silica gel suggests that many adsorption-desorption cycles are possible. A total Ru loading of about 97 g/ft³ of silica gel and an average decontamination factor of 1,013 was obtained in one adsorption run by adsorbing 59 g/ft³ on silica gel that already contained 38 g/ft³ as a residue from three previous adsorption-desorption cycles. (auth)

20042 TID-3555

Office of Technical Information Extension, AEC.

RADIOACTIVE WASTE PROCESSING AND DISPOSAL.

A Literature Search. Theodore F. Davis, comp. June 1960. 98p. OTS.

This supplement to TID-3311 consists of 696 references to report and published literature on radioactive waste processing and disposal. The periods covered are January 1958 to May 1960 for report literature and January 1951 to May 1960 for published literature. (C.H.)

20043

IMPROVEMENTS IN OR RELATING TO THE CLEANING

OF URANIUM WASTE. Oliver Flint (to United Kingdom Atomic Energy Authority). British Patent 836,570. June 9, 1960.

A simple and inexpensive process is presented for cleaning uranium waste from machining operations and for compaction or compression of the cleaned waste for remelting and casting. The U in the form of machining waste is brought into contact with a solution of a dicarboxylic acid and a ferric salt of a dicarboxylic acid containing a small amount of a surface active agent until the tarnish is removed. The U is then washed free of solution, dried, and compacted. (W.L.H.)

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